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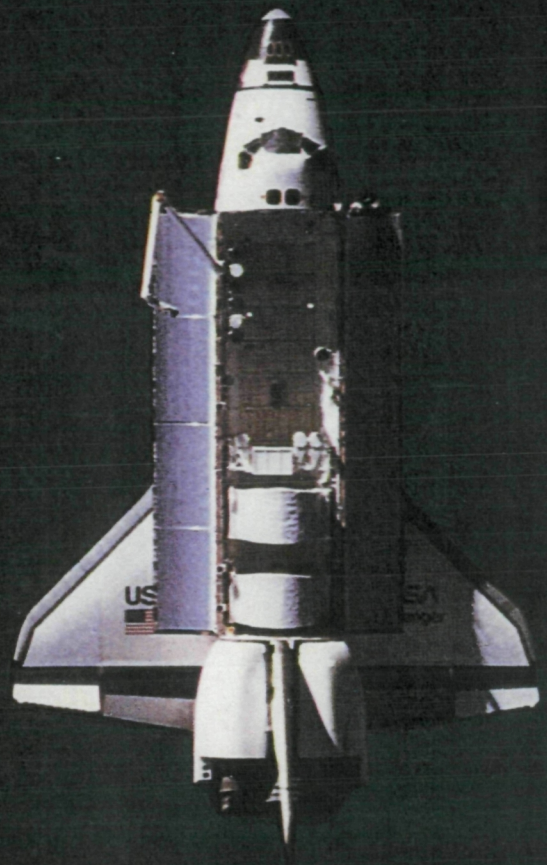

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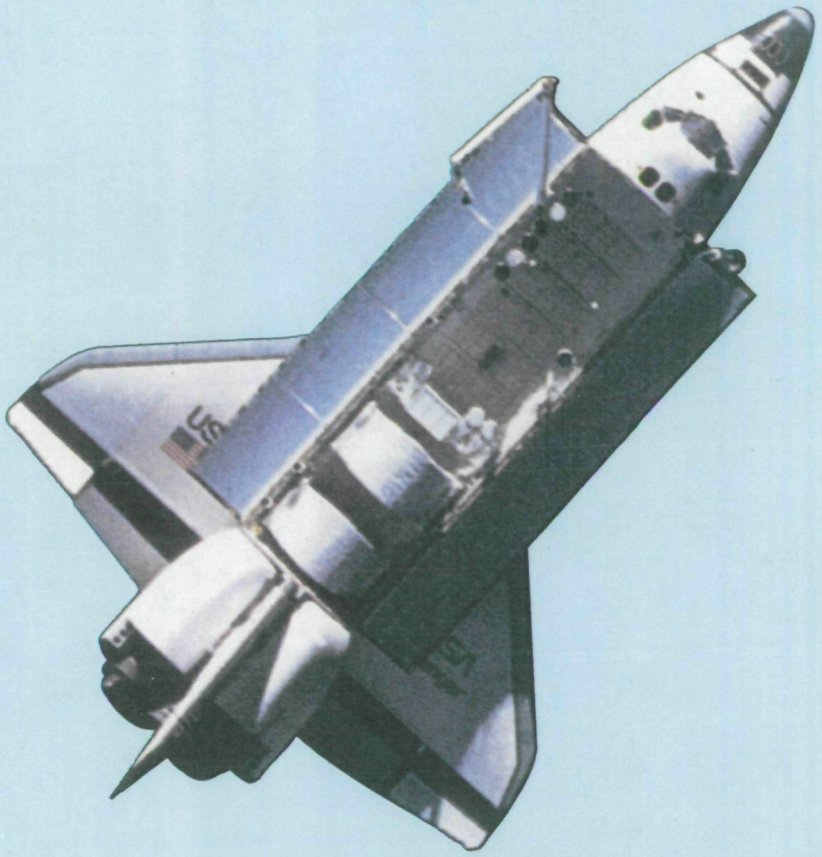

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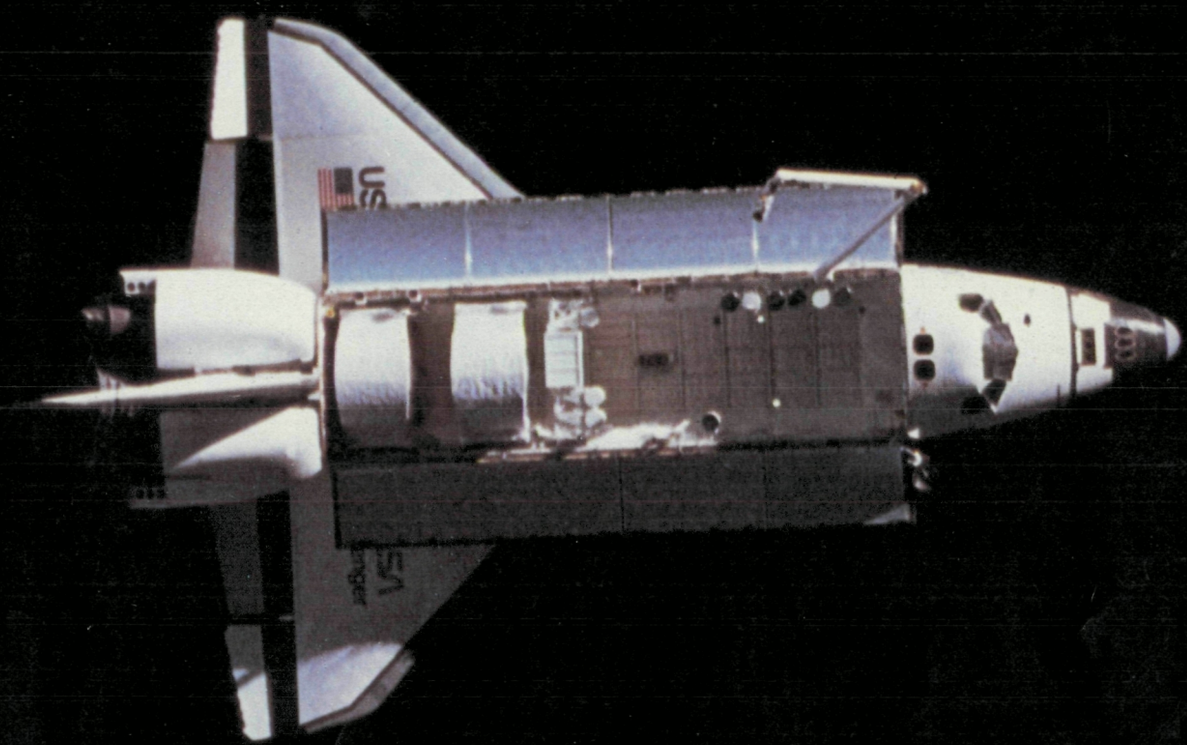
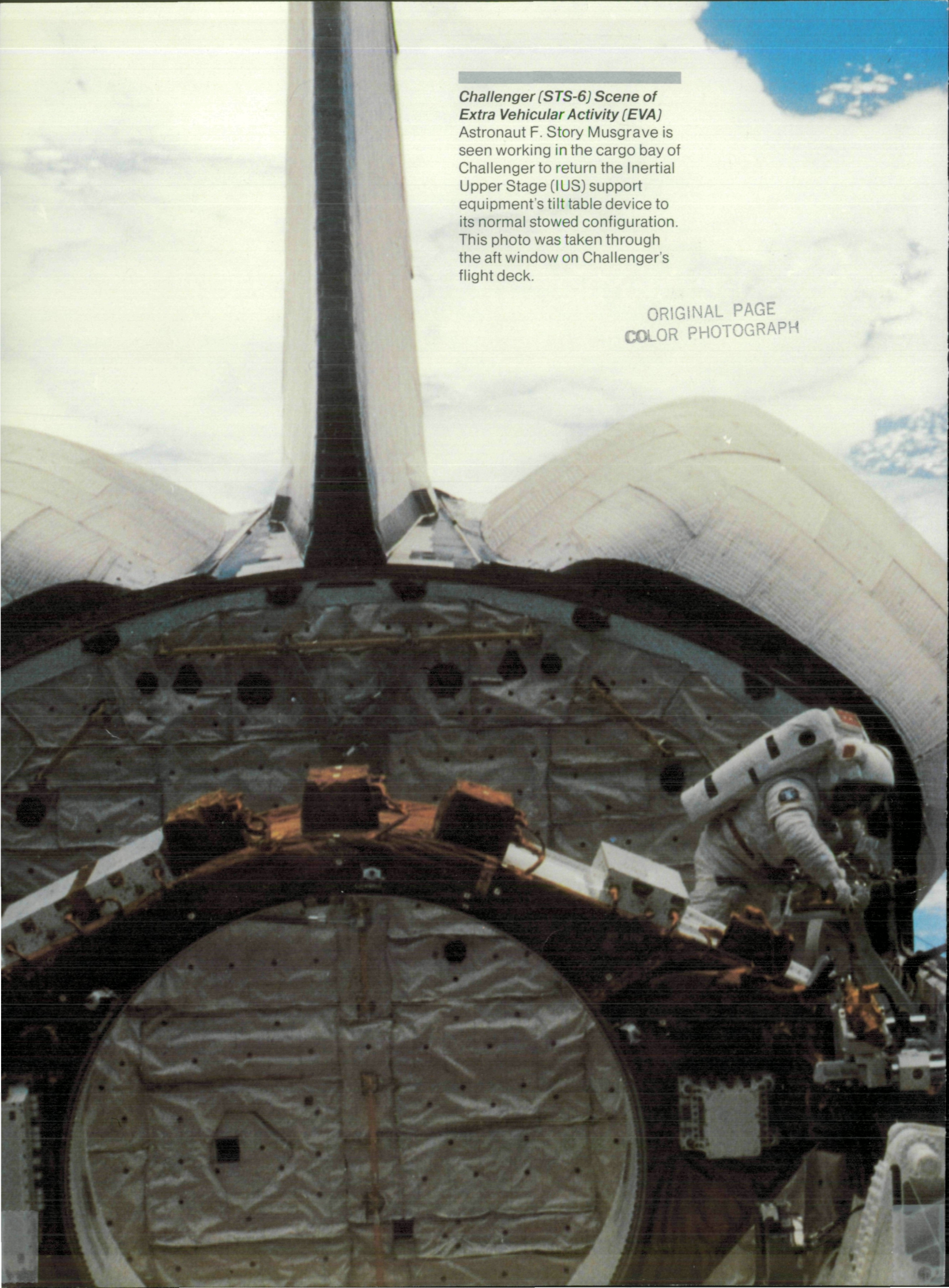


STS-7 Challenger Viewed from SPAS-01 Satellite This photo taken on June 22, 1983 of the Space Shuttle orbiter Challenger shows, for the first time, a Space Shuttle in Earth-orbit. A 70 millimeter camera mounted on the German-built Shuttle Pallet Satellite (SPAS-01) took this picture while SPAS-01 was free-flying in close formation with Challenger.



Challenger (STS-6) Scene of Extra Vehicular Activity (EVA)
Astronaut F. Story Musgrave is seen working in the cargo bay of Challenger to return the Inertial Upper Stage (IUS) support equipment's tilt table device to its normal stowed configuration. This photo was taken through the aft window on Challenger's flight deck.

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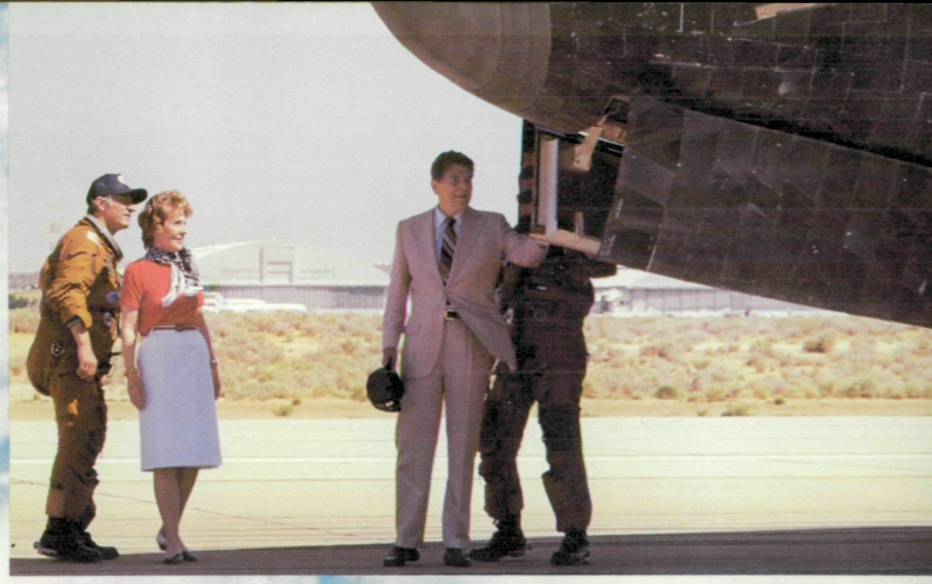

President and Mrs. Reagan Inspect Columbia after Edwards AFB Landing From left to right, Astronaut Henry Hartsfield (Pilot), Mrs. Nancy Reagan, President Ronald Reagan and Astronaut Thomas Mattingly (Commander). This Presidential inspection of Columbia occurred July 4, 1982 at Edwards AFB, California immediately after Columbia had successfully completed the fourth Space Shuttle flight.

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"Throughout history we've never shrunk before a challenge. . . . The space program, in general, and the Shuttle program, in particular, have gone a long way to help our country recapture its spirit of vitality and confidence. The pioneer spirit still flourishes in America. . . .

"In the future, as in the past, our freedom, independence and national well-being will be tied to new achievements, new discoveries and pushing back frontiers. . . .

"Columbia and her sister ships will . . . provide economical and routine access to space for scientific exploration. . . . Simultaneously, we must look aggressively to the future by demonstrating the potential of the Shuttle and establishing a more permanent presence in space. We've only peered over the edge of our accomplishments; yet already the space program has improved the lives of every American. . . .

"There are those who thought the closing of the western frontier marked an end to America's greatest period of vitality. Yet we are crossing new frontiers every day. The high technology now being developed, much of it a by-product of the space effort, offers us and future generations of Americans opportunities never dreamed of a few years ago. . . . the limits of our freedom and prosperity have again been expanded by meeting the challenge of the frontier."

From remarks by
President Ronald Reagan
On the landing of the
Space Shuttle Columbia,
Edwards Air Force Base, Calif.
July 4, 1982

Administrator Beggs Monitors Voyager Imagery
NASA Administrator James M. Beggs is seen at left among a group of NASA scientists watching the return of imagery from Voyager I on its flight past Jupiter and its moons.

"By doing what we do and continuing to push to do more in space, we not only advance the boundaries of knowledge on Earth, but those of technology itself. . . .

"The space program pays another dividend and that is the stimulus it gives to our young people to study science and engineering and to work toward proficiency and excellence at all levels of their education. . . .

"The fact that our country is willing to take on difficult things, projects that are indeed wondrous and exciting, stimulates our young people to set their sights and their goals high—to pursue excellence. . . .

"I could not imagine America without its space program. It adds an excitement and a zest to our lives that we just could not get any other way.

"James Michener has called the future of space exploration 'a challenge of a compelling nature.' Over the past 25 years nowhere has this challenge been met more vigorously than in the United States, a nation with a pioneer tradition, where the urge to know the unknown runs deep."

From an address by
NASA Administrator James M. Beggs
Before the
International Platform Association
August 5, 1983
Washington, D.C.

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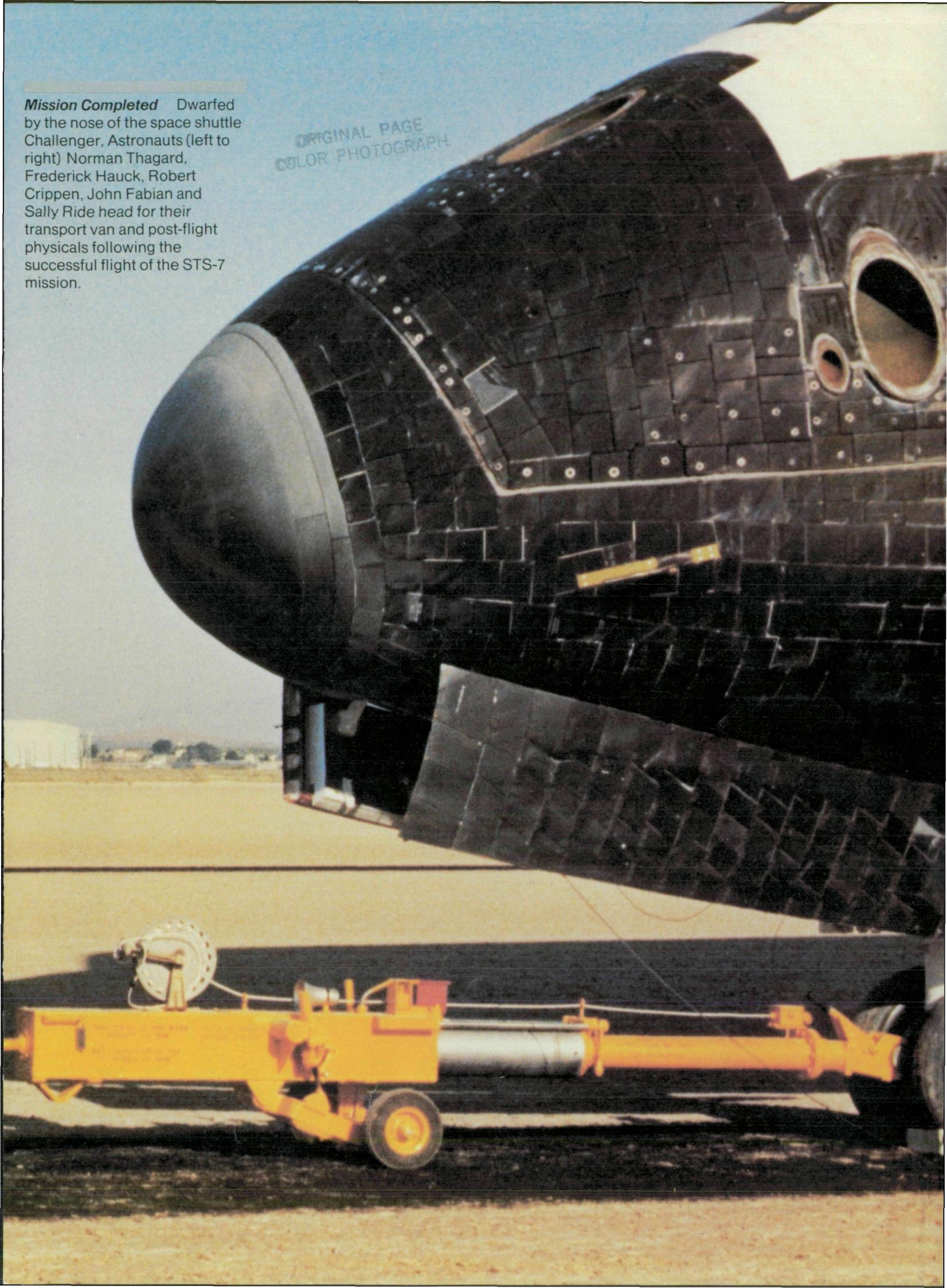

Mission Completed Dwarfed by the nose of the space shuttle Challenger, Astronauts (left to right) Norman Thagard, Frederick Hauck, Robert Crippen, John Fabian and Sally Ride head for their transport van and post-flight physicals following the successful flight of the STS-7 mission.

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Surrealistic View of Challenger at Kennedy Space Center
The fully assembled Space Shuttle Challenger presents a surrealistic scene as it moves down the fog-shrouded three-and-one-half mile crawlerway toward Launch Pad 39-A. This six-hour trip preceeded the launch of the sixth Space Shuttle mission (STS-6) in January 1983.

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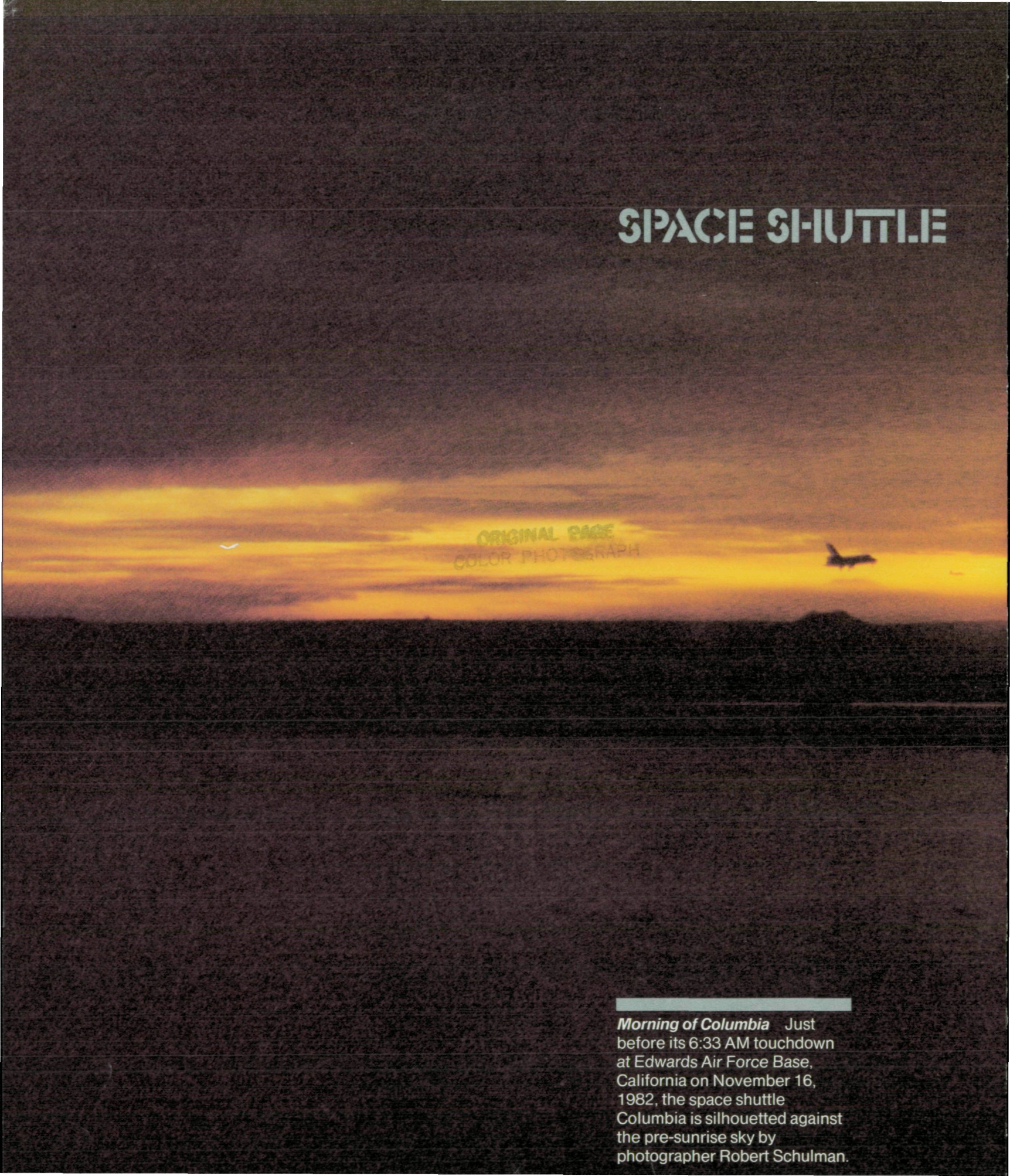
AN ANNIVERSARY OF PROGRESS

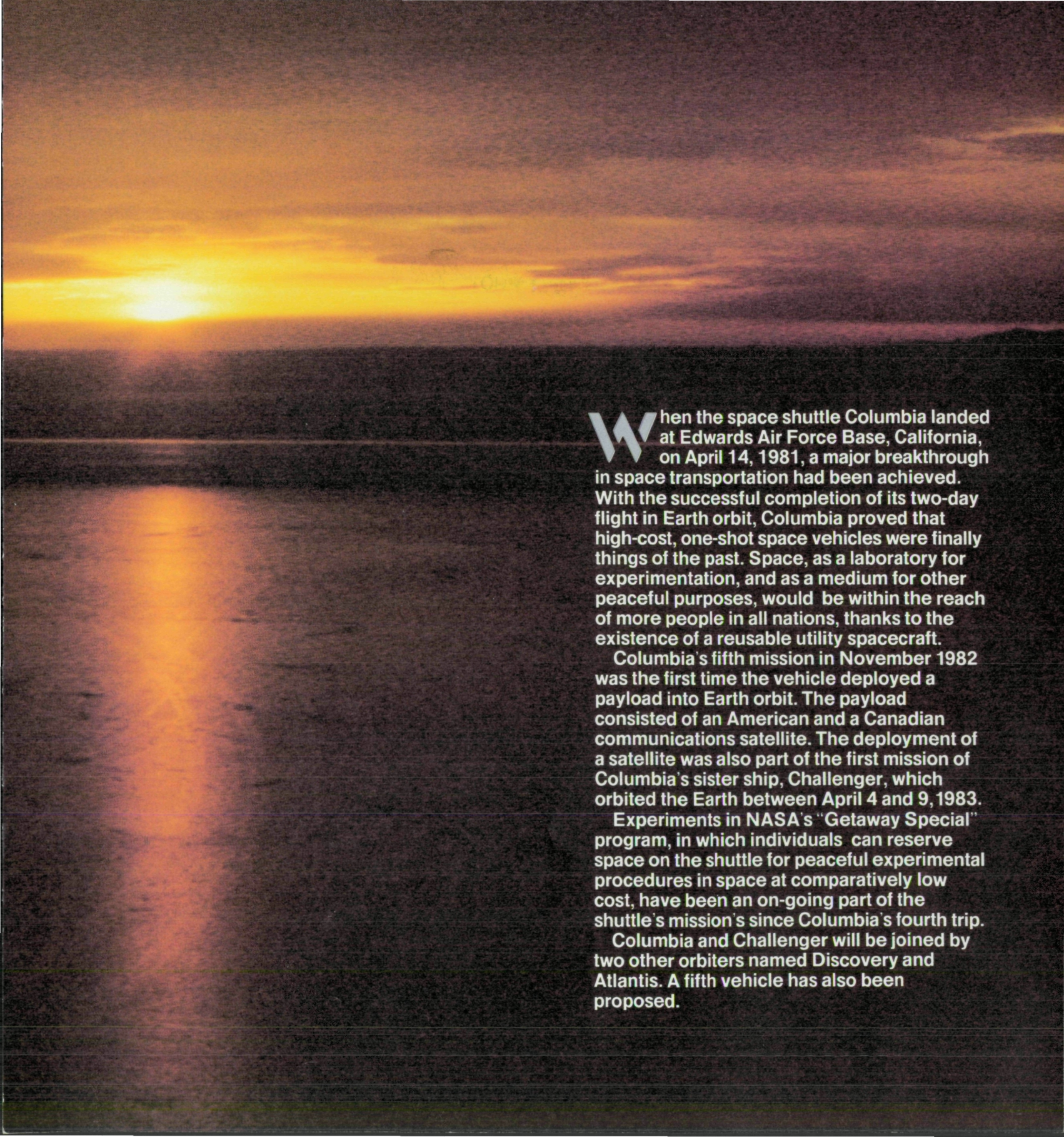
On October 1, 1958, the National Aeronautics and Space Administration was established to make the United States the leading nation in the space sciences and in aeronautical research. Yet, 25 years ago, it was easy to doubt that world leadership in space could ever be an American prerogative. The year before NASA's birth, the Soviet Union had orbited Sputnik I, the world's first man-made Earth satellite, and a second Sputnik quickly followed. Early American attempts to match the Soviet space feat ended in failure. In the aftermath of the Russian accomplishments in space, it became clear that an organization had to be formed to coordinate the massive effort needed to make the United States an important contender in what was then called the space race. Thus, with President Eisenhower's signature on the National Aeronautics and Space Act of 1958, NASA absorbed the National Advisory Committee for Aeronautics and most of the fragmented American space program, then being pursued by the military.

NASA's dedicated men and women changed the United States from dark horse in the space race to favorite. The United States has landed astronauts on the Moon six times. American space probes are travelling to the extremes of the solar system and beyond and transmitting data which is throwing out old theories and changing our understanding of the planets. American communications satellites have revolutionized the telecommunications industry. The Earth sciences are undergoing major changes thanks to American-made weather and mapping satellite systems. The United States is the leading nation in aircraft research and development. Journeys to and from Earth orbit in reusable space vehicles are becoming routine, bringing major construction projects in space, such as large orbiting space stations, within the realm of practicality. The gravitational bonds of Earth have been thrown off forever.

This volume is a pictorial retrospective of NASA's first 25 years. It is an anniversary of extraordinary technological progress. The photographs shown here were selected from literally thousands of excellent pictures which recorded nearly every significant moment of the challenge to put Americans into space and return them safely to Earth. It is an album depicting highly competent professionals and the most technologically sophisticated equipment ever produced. It is as much a record of where NASA has been as it is a beacon of where it is going in the challenge to understand the world and the universe.



Morning of Columbia Just before its 6:33 AM touchdown at Edwards Air Force Base, California on November 16, 1982, the space shuttle Columbia is silhouetted against the pre-sunrise sky by photographer Robert Schulman.



When the space shuttle Columbia landed at Edwards Air Force Base, California, on April 14, 1981, a major breakthrough in space transportation had been achieved. With the successful completion of its two-day flight in Earth orbit, Columbia proved that high-cost, one-shot space vehicles were finally things of the past. Space, as a laboratory for experimentation, and as a medium for other peaceful purposes, would be within the reach of more people in all nations, thanks to the existence of a reusable utility spacecraft.

Columbia's fifth mission in November 1982 was the first time the vehicle deployed a payload into Earth orbit. The payload consisted of an American and a Canadian communications satellite. The deployment of a satellite was also part of the first mission of Columbia's sister ship, Challenger, which orbited the Earth between April 4 and 9, 1983.

Experiments in NASA's "Getaway Special" program, in which individuals can reserve space on the shuttle for peaceful experimental procedures in space at comparatively low cost, have been an on-going part of the shuttle's mission's since Columbia's fourth trip.

Columbia and Challenger will be joined by two other orbiters named Discovery and Atlantis. A fifth vehicle has also been proposed.

Moving the Challenger
America's second manned reusable spacecraft, the space shuttle Challenger, is shown on July 3, 1982, being moved to the Dryden Flight Facility at Edwards Air Force Base, California, from the Rockwell factory in Palmdale, California, where it was built. Among the improvements in Challenger were weight-saving design changes which made it 1,119 kilograms (2,486 pounds) lighter than Columbia. At Edwards, the space craft was mated to its Boeing 747 carrier plane for the transfer flight to the Kennedy Space Center at Cape Canaveral, where it was launched into Earth orbit on April 4, 1983.

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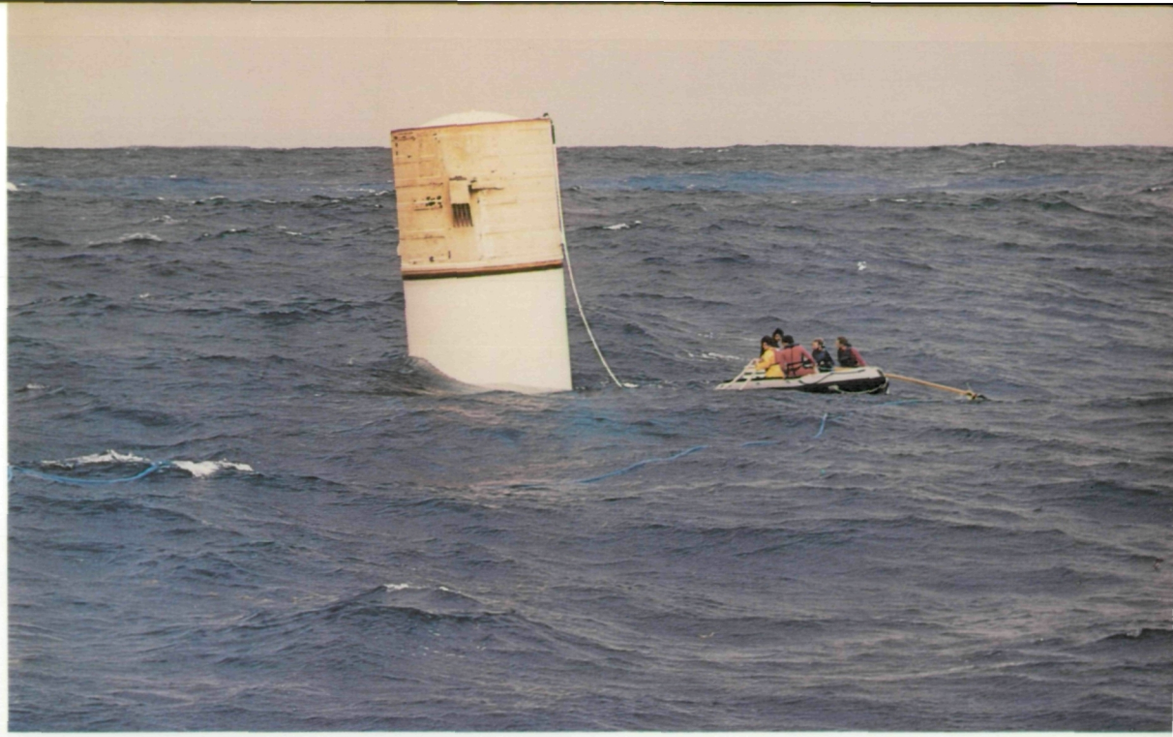
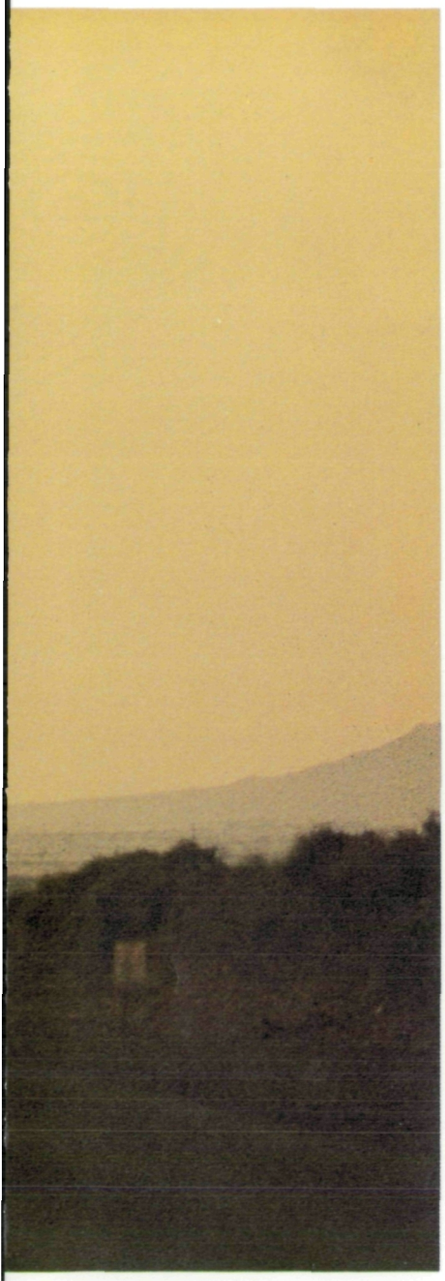
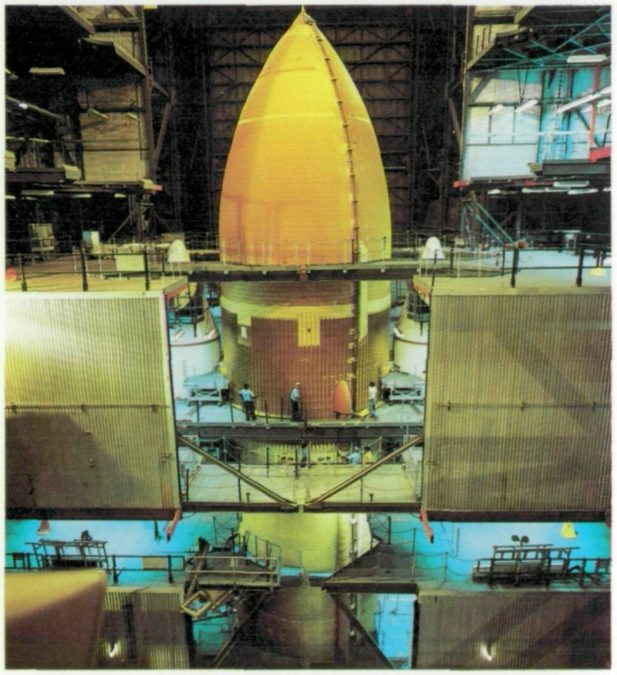


Recovery of Reusable Solid Rocket Booster Recovery team members from the NASA recovery ship UTC Liberty perform recovery operations on one of STS-2's solid rocket boosters. The booster has just separated from Columbia and descended by automatic-deploying parachutes into choppy Atlantic seas.





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Space Shuttle Fuel Tank The lightweight external fuel tank which will be flown on the space shuttle Challenger during its lift-off phase is shown being mated to Challenger's two solid fuel rocket boosters. The procedure is taking place on the mobile launch platform within the vehicle assembly building at the Kennedy Space Center at Cape Canaveral in October 1982.

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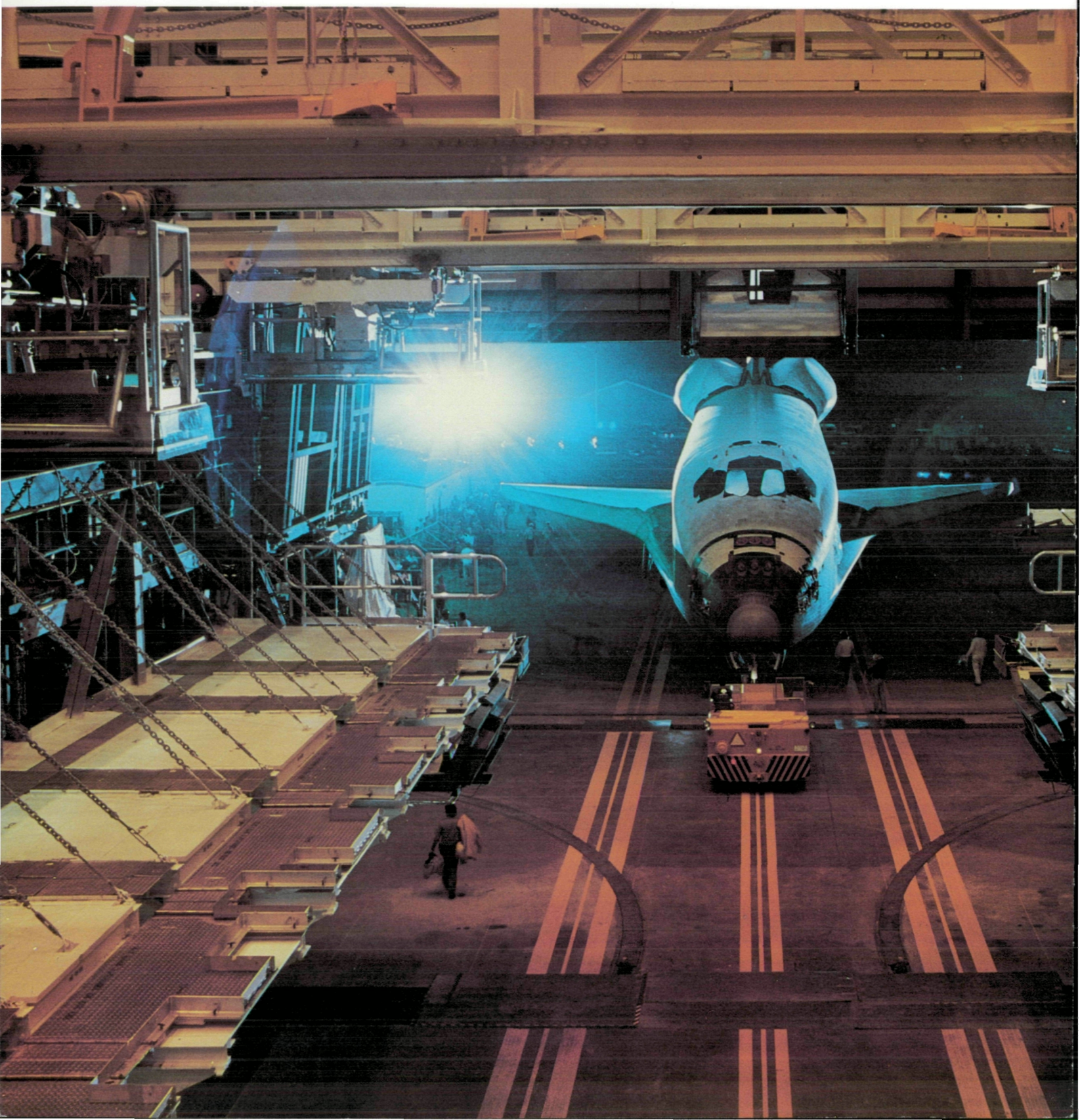
Columbia is Backed Out of Its Workstand at Kennedy Space Center The payload bay doors are secured as the preparations for the third mission of Columbia (STS-3) move from the Orbiter Processing Facility to the Vehicle Assembly Building.



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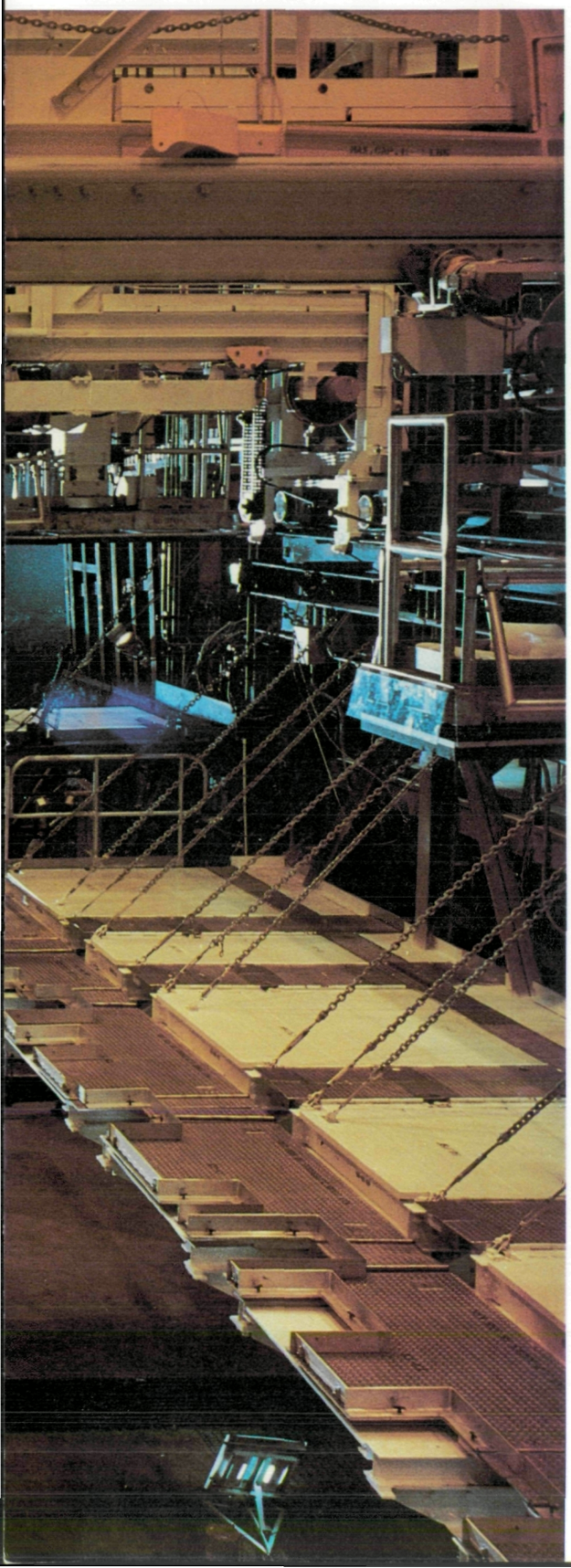
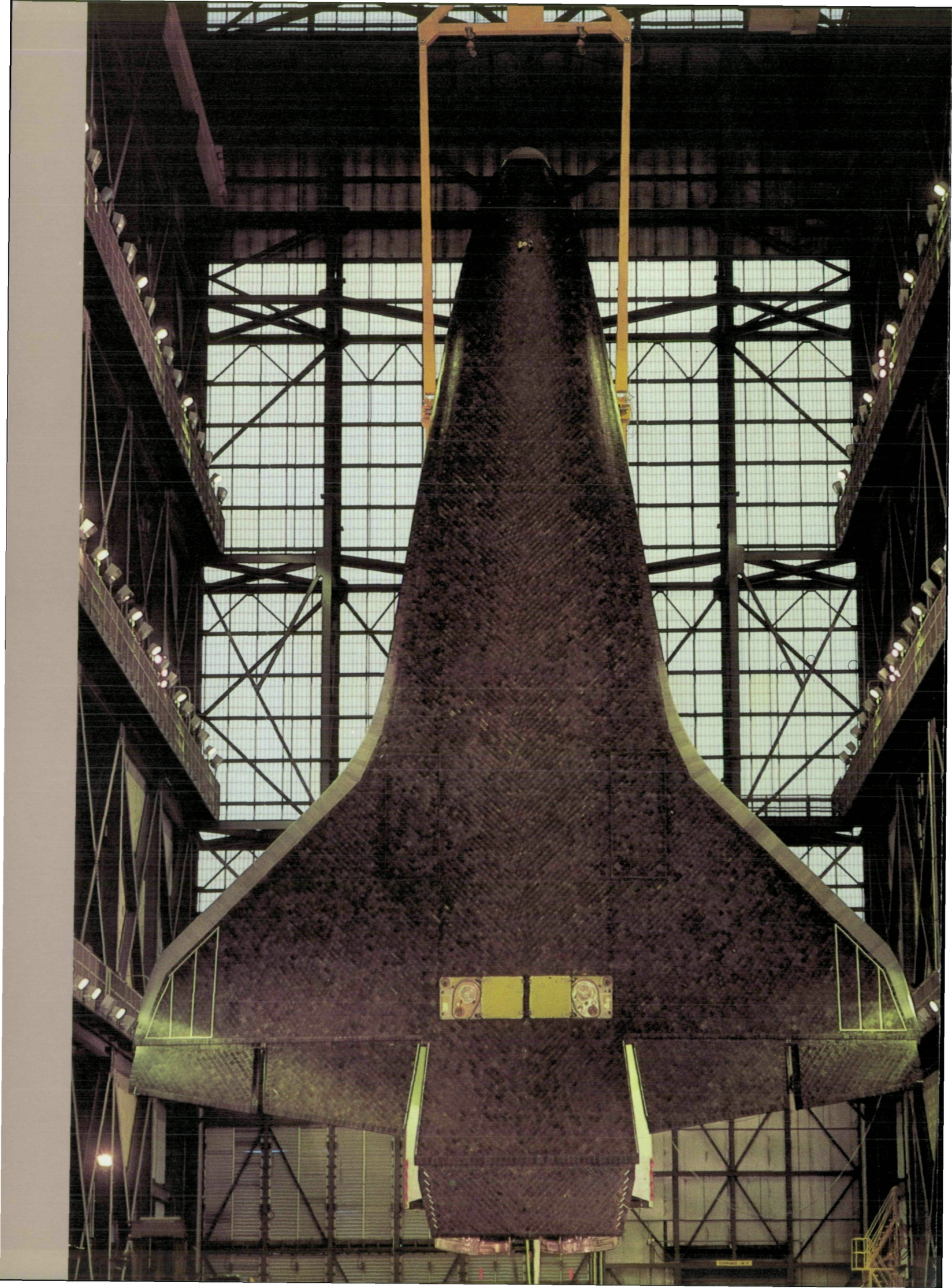


Columbia Atop Boeing 747 Carrier After completion of the second Space Shuttle flight, the orbiter Columbia is being returned to Kennedy Space Center on top of its Boeing 747 Shuttle Carrier Aircraft.



Space Shuttle at Pre-Launch The space shuttle Columbia, looking like a great bird in a giant cage, is shown within the vehicle assembly building at the Kennedy Space Center at Cape Canaveral in this December 1980 photograph by Rene Burri. Columbia made its first Earth orbital flight after lift-off from Cape Canaveral on April 12, 1981, with Astronauts John W. Young and Robert L. Crippen aboard. On April 14, the flight landed with a perfect touchdown at Rogers Dry Lake in California's Mohave Desert. The premier space shuttle mission was designated STS-1.

Mounting Tiles At the Kennedy Space Center at Cape Canaveral, a technician from Rockwell International mounts some of the 34,000 individual ceramic tiles which make up the thermal protection system on the space shuttle Columbia. The system of tiles helps to absorb the intense heat encountered by Columbia during its fiery re-entry to Earth. This photograph was taken in July 1980 by Robert Schulman.

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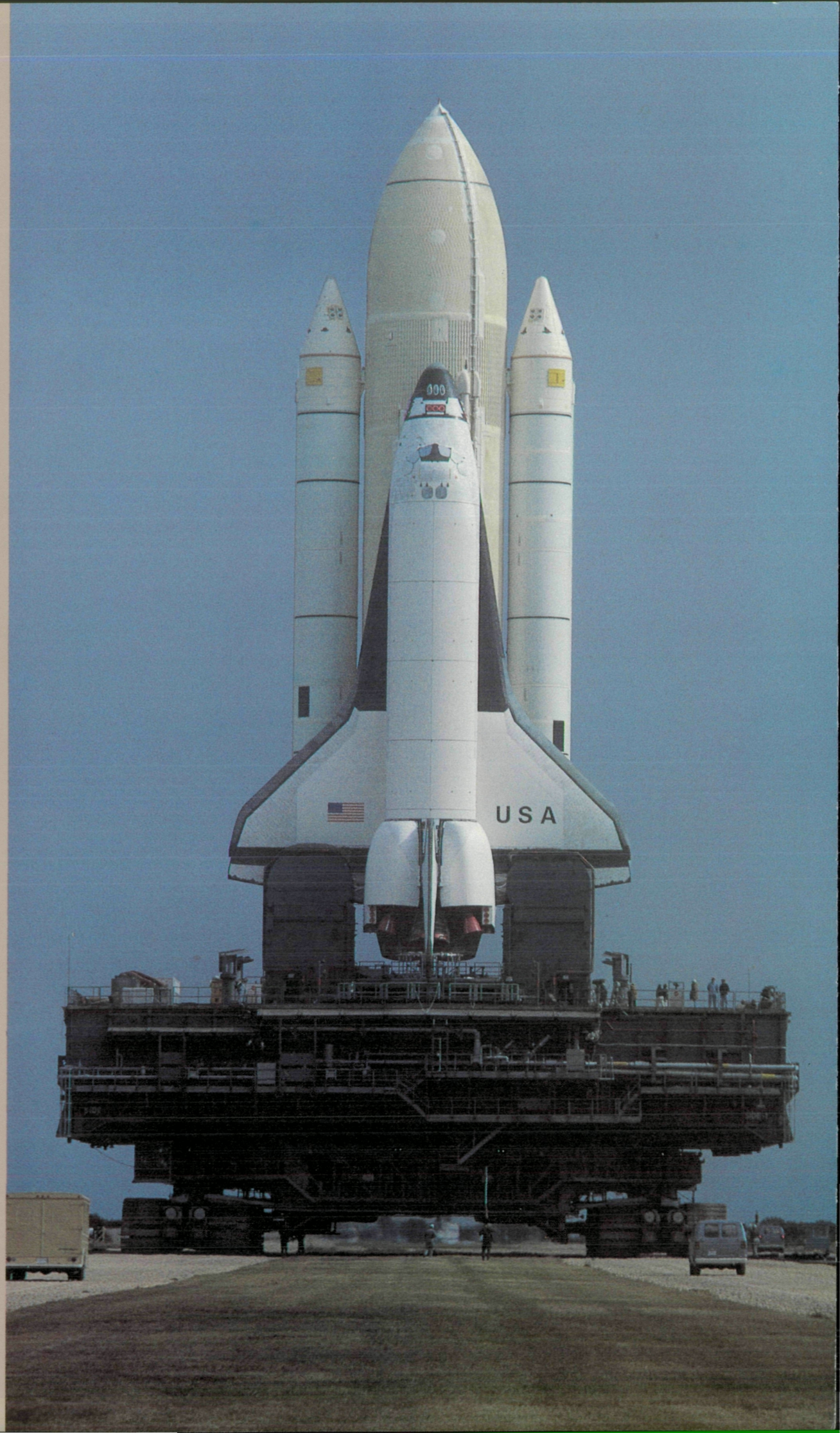
Rollout-Ready The space shuttle Columbia is shown ready to be rolled out of the vehicle assembly building at the Kennedy Space Center at Cape Canaveral, on the morning of December 29, 1980. By mid-afternoon of that day, it was on its launch pad in preparation for its April 12, 1981 launch with astronauts John W. Young and Robert L. Crippen aboard. On April 14, it made a successful landing at Edwards Air Force Base, California, to conclude America's first space shuttle mission.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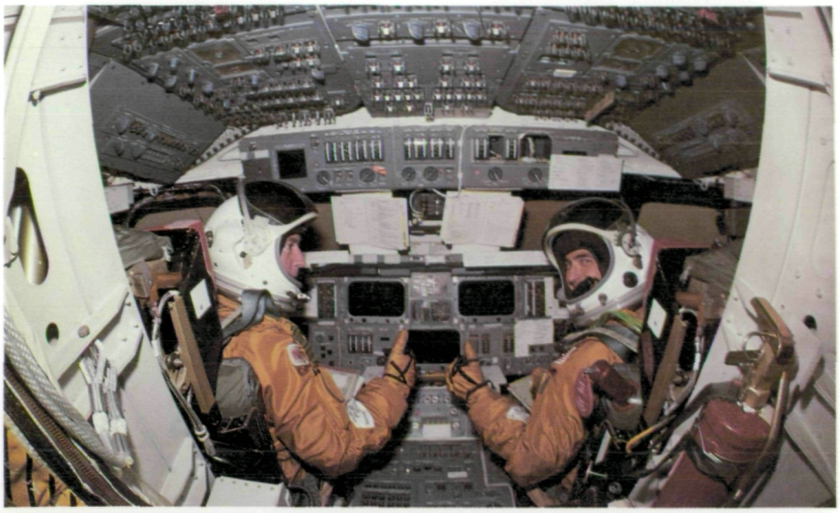

Simulated Shuttle Preparing for the inaugural flight of the Space Shuttle Columbia, Astronauts John Young at left, and Robert Crippen go over their checklist during a power-up mission simulation in the Columbia's processing facility. This photo was taken aboard Columbia at the Kennedy Space Center at Cape Canaveral in October 1980.

Astronauts Crippen and Young STS-1 Astronauts Robert Crippen (left) and John Young (right), the prime crew for the maiden flight of the Space Shuttle, participate in Orbiter Integrated Tests (OIT) at Kennedy Space Center prior to the flight.

Rollout The space shuttle Columbia, its booster rockets and fuel tank attached, is seen rolling out of the vehicle assembly building at the Kennedy Space Center at Cape Canaveral, Fla. in this January 1981 photograph by Rene Burri.

Intense Astronaut Training
Astronauts Daniel C. Brandenstein (left) and Guion S. Bluford (right) man the ascent and entry stations in a simulated mission being "flown" in the Johnson Space Center simulator. Brandenstein is in the pilot's position, while Bluford monitors a simulated "nominal" mission.

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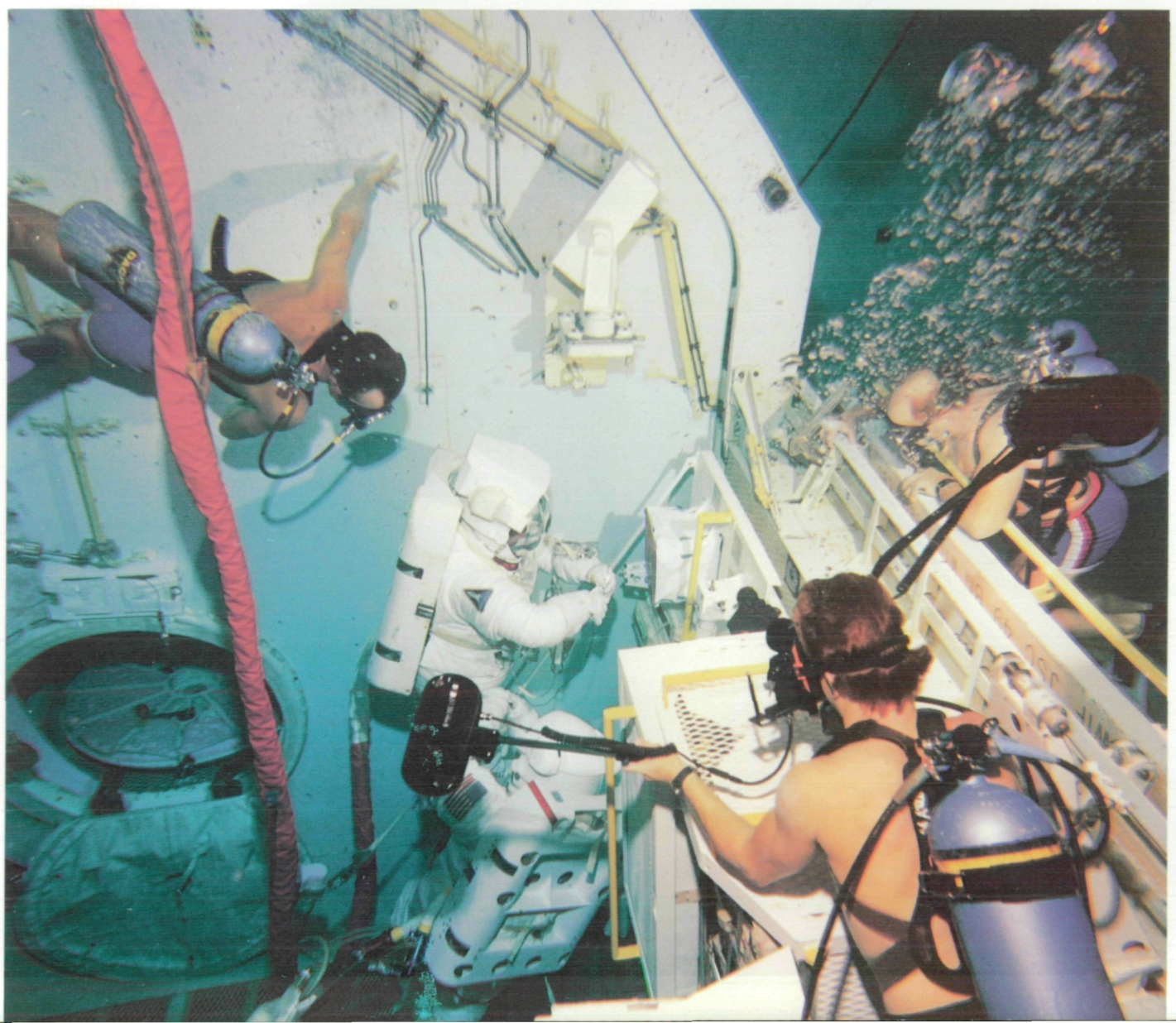

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Training in Weightlessness
Astronauts William B. Lenoir and Joseph P. Allen IV, both STS-5 Mission Specialists, train in the simulated weightless environment of the Johnson Space Center's Weightless Environment Training Facility (WET-F).

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Water Survival Training
Astronaut Joe H. Engle, back-up crew commander for the first flight of the space shuttle Columbia, releases a flare while afloat in the Gulf of Mexico off the Coast of Florida, during water survival training. This photograph was made in April 1980.

Underwater Weightless Training
Scientist-Astronaut Anna L. Fisher is standing on a movable platform which will lower her underwater at NASA's weightless environment training facility at the Lyndon B. Johnson Space Center in Houston, Texas. The new water immersion facility, which opened in 1980, has been set up to train space shuttle astronauts. The facility contains a 100 by 235 by 75-meter (33 by 78 by 25-foot) pool in which a space shuttle mock-up can be submerged.

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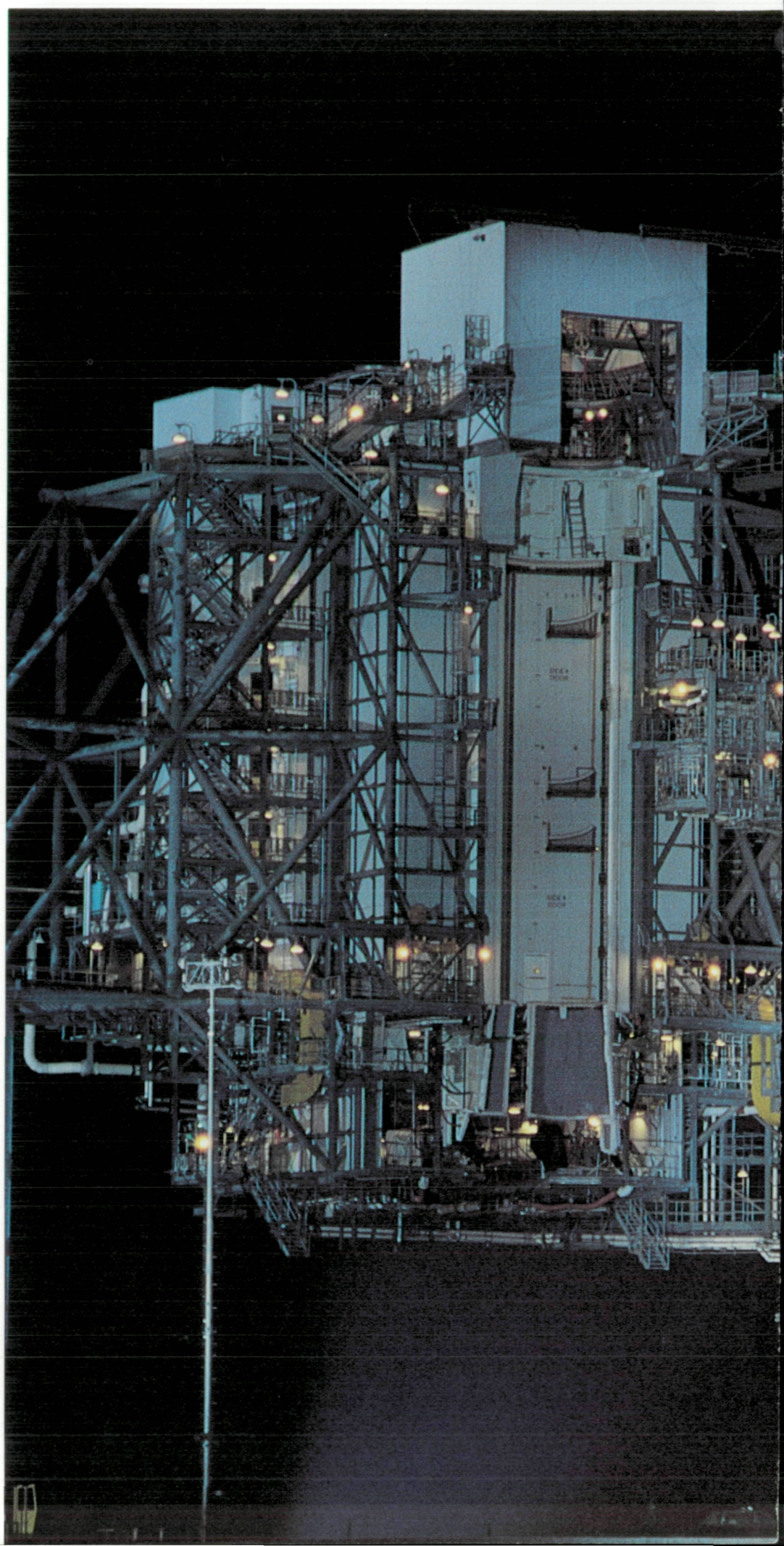

Nighttime Shuttle Like a giant citadel of technology the Space Shuttle Columbia makes a glittering sight on its launch pad at the Kennedy Space Center at Cape Canaveral . This photograph was taken by Rene Burri shortly before Columbia made its maiden flight on April 12, 1981, with Astronauts John W. Young and Robert L. Crippen aboard.

At Mission Control Dr. Hans Mark (right), NASA deputy administrator, is shown at the Johnson Space Center in Houston as he listens to the latest status information on STS-2, NASA's second space shuttle mission. The information is coming from the Kennedy Space Center at Cape Canaveral where Columbia is about to be launched. The date is November 4, 1981, and moments after this picture was taken, the mission was put on hold for approximately 48 hours. Columbia was finally sent off on its second Earth orbital trip on the morning of November 6.

Launch Work-Up Moments before it lifted off its launch pad at the Kennedy Space Center at Cape Canaveral, the space shuttle Columbia's huge booster rockets began to generate energy to lift the spacecraft through the atmosphere into Earth orbit. This photograph, taken by a remote camera attached to the launch gantry, was made on June 27, 1982, as Columbia was about to begin its fourth mission, which was designated STS-4. Aboard Columbia were astronauts Thomas K. Mattingly II and Henry Hartsfield, Jr. The final mission to specifically test the space shuttle as a system, Columbia landed successfully at Edwards Air Force Base, California, on July 4. The mission also included the first of the "Getaway Special" payloads, which are oil-drum-sized self-contained modular experiments done aboard the shuttle under microgravity conditions.

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Columbia Ascending In a burst of gold reflected in the waters around its launch pad, the space shuttle Columbia blasts skyward from the Kennedy Space Center at Cape Canaveral in the late morning of March 22, 1982. STS-3 was manned by astronauts Jack Lousma and Gordon Fullerton, who kept the shuttle in Earth orbit for over eight days before bringing the vehicle to a safe landing on March 30 at the Northrup Air Strip at the White Sands Test Facility in New Mexico. It was the third mission for Columbia. The mission included experiments to sense the orbiter's environment, observe the Sun, as well as materials processing tests and a zero-gravity plant growing experiment. The shuttle's remote manipulator arm, which lifts cargo out of the cargo bay, was also tested.

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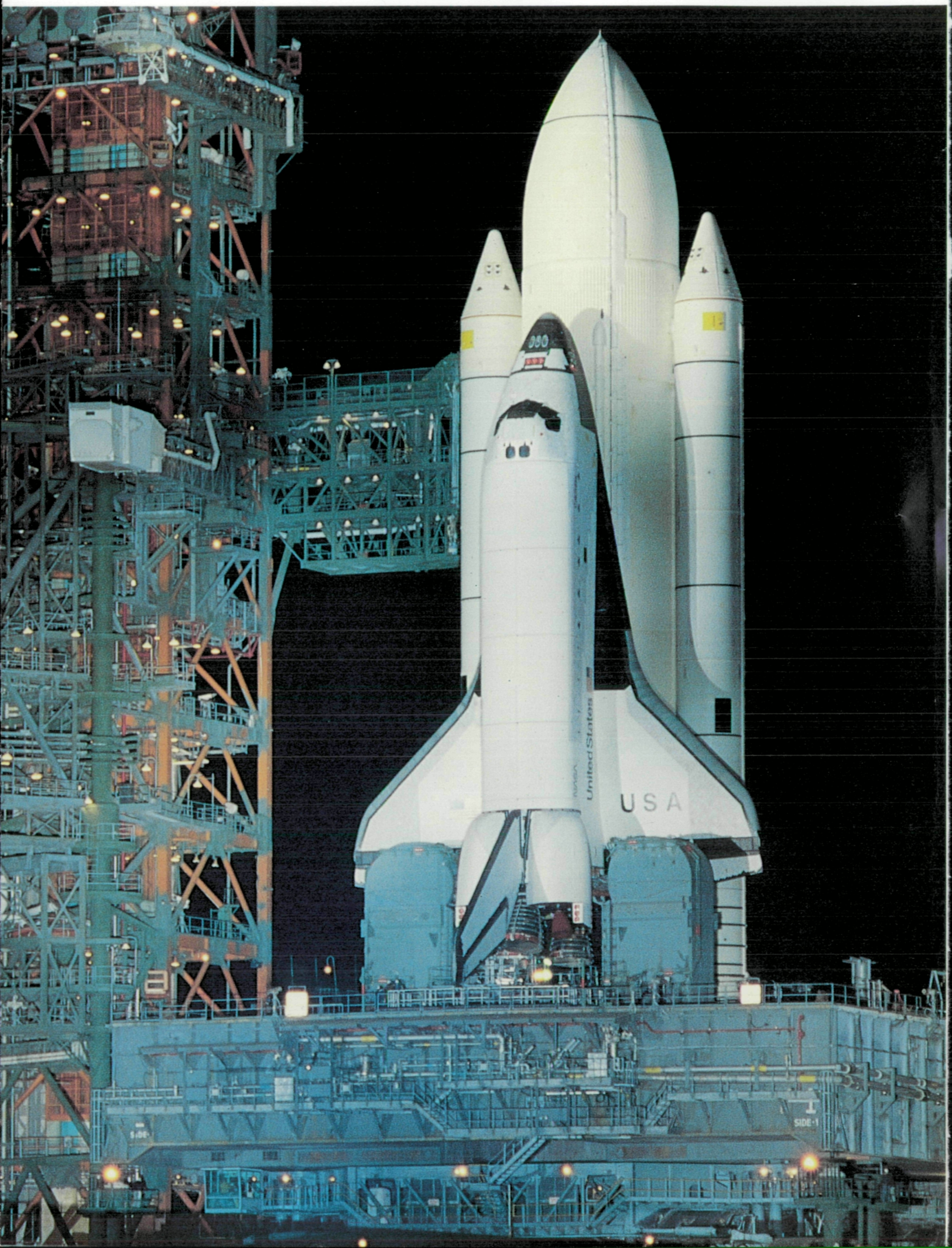

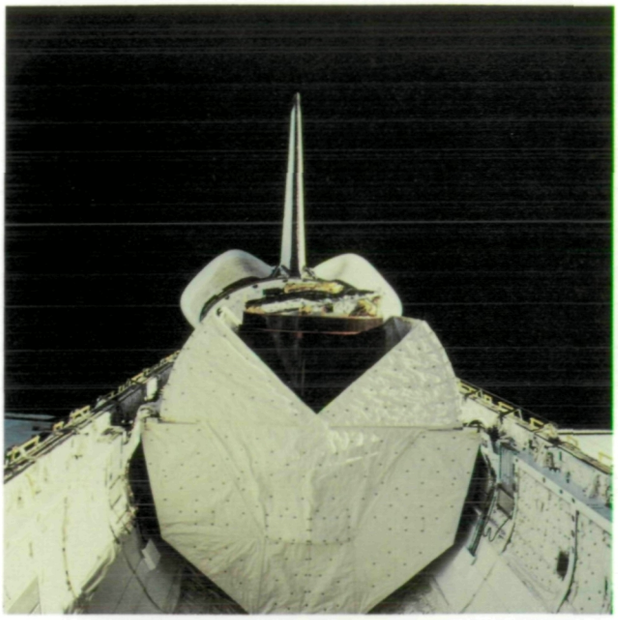

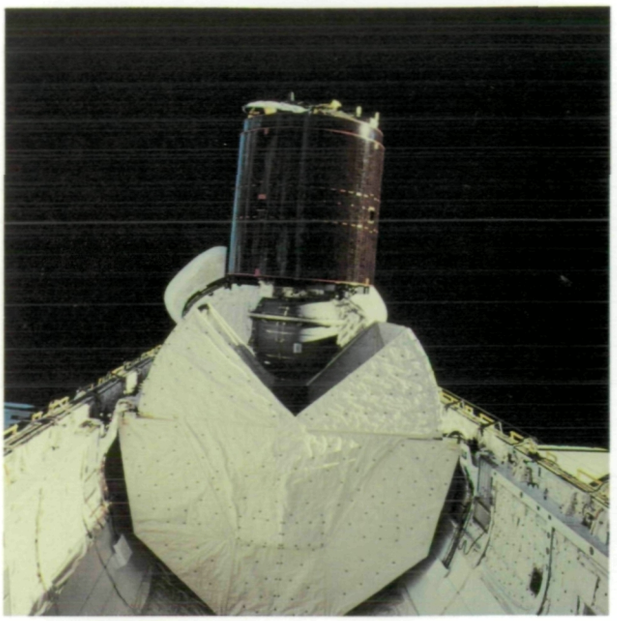

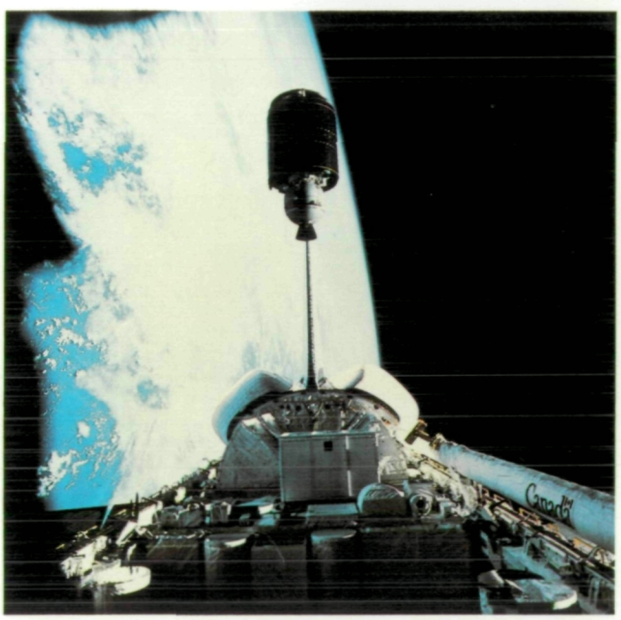

Palapa B Launched from Shuttle Moments after its release from the grasp of the Canadian-built Remote Manipulator Arm, the Indonesian communications satellite Palapa B rises above the vertical stabilizer of the Challenger.

Deploying a Satellite in Space This series of photographs, taken by a hand held camera from the space shuttle Columbia in Earth orbit, shows the deployment in space of Satellite Business System's communications satellite SBS-3. This was the first time that a payload was dispatched from the cargo hold of Columbia. SBS-3 was orbited shortly after Columbia's November 11, 1982, launch from the Kennedy Space Center at Cape Canaveral.
The next day, another communications satellite, the Canadian Anik C-3 owned by Telesat Canada was successfully lifted out of the shuttle's cargo hold and orbited. It is shown with the Earth as a backdrop. The mission, designated STS-5, was Columbia's fifth. STS-5 was manned by astronauts Vance D. Brand, Robert V. Overmyer, Joseph P. Allen and William B. Lenoir—two more crew members than previously used on space shuttle missions. STS-5 landed safely at Edwards Air Force Base, California, on November 16.

Mission Specialist Sally Ride at Work Astronaut Sally K. Ride, mission specialist aboard STS-7, uses a 35mm camera to record a test specimen's activity in the Continuous Flow Electrophoresis System (CFES).

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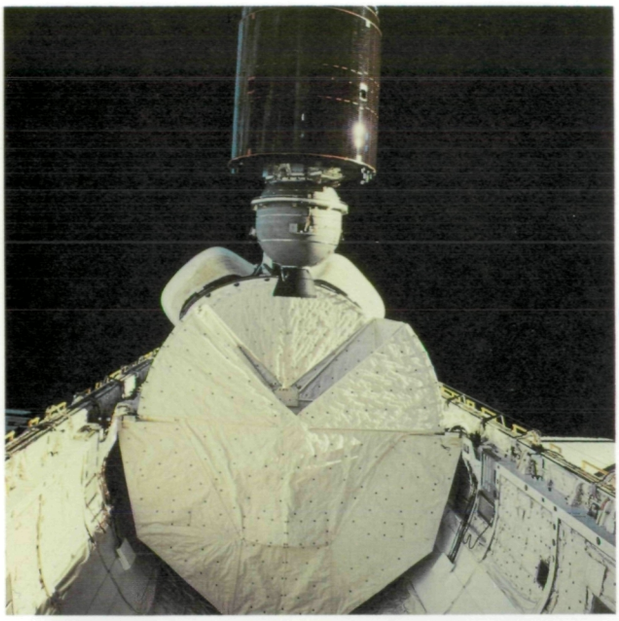

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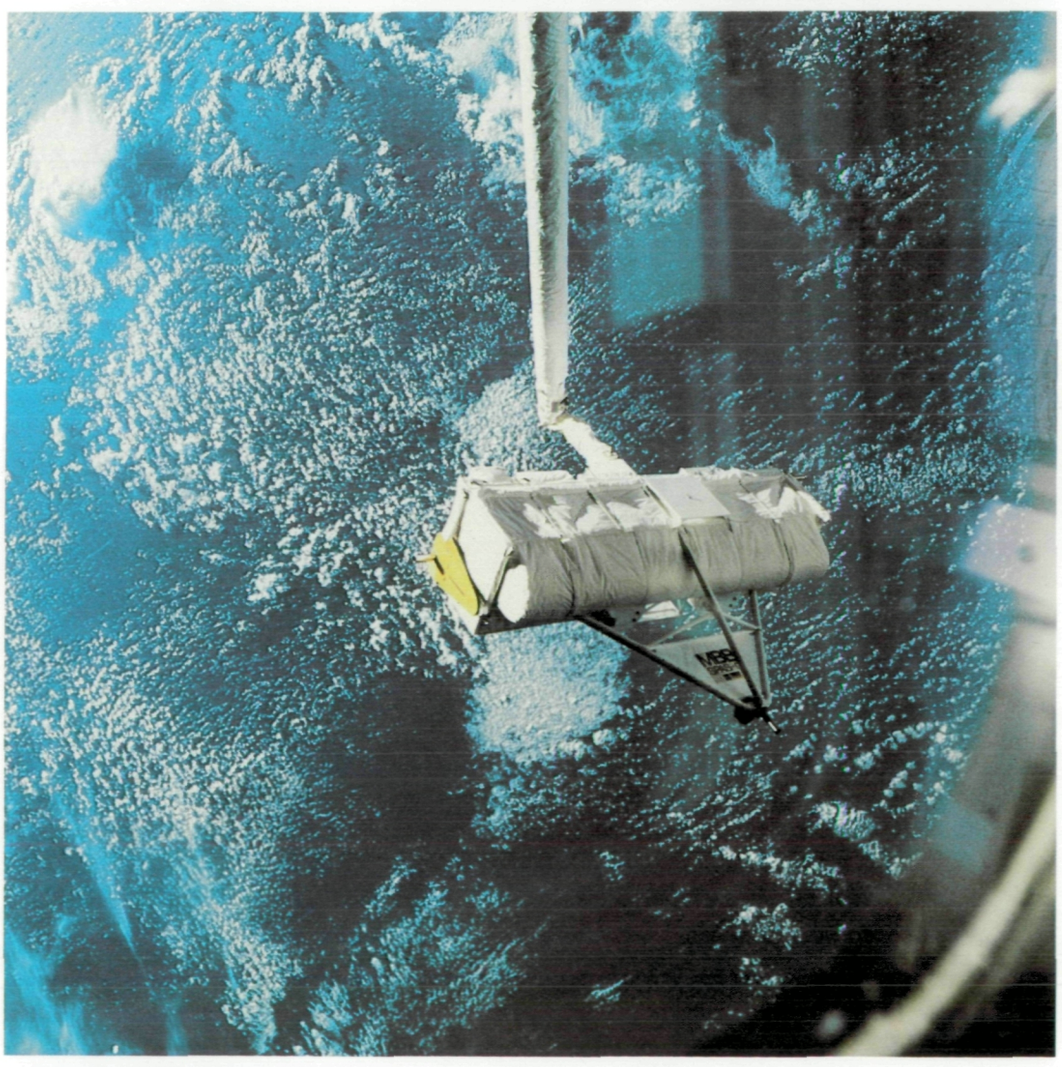
We Deliver A pre-set 35mm camera snapped this picture aboard the space shuttle Columbia in Earth orbit of Astronauts (clockwise from top left) William B. Lenoir, Robert F. Overmyer, Joseph P. Allen and Vance D. Brand, who is holding the sign with the slogan which became identified with STS-5, Columbia's fifth mission. The STS-5 mission was the first one in which a payload was deployed in space from the shuttle's cargo bay. Shortly after its November 11, 1982 lift-off from the Kennedy Space Center at Cape Canaveral, the shuttle placed in Earth orbit the Satellite Business System's SBS-3 communications satellite. A day later, a Canadian communications satellite, the Anik C-3, was orbited.



Delivery by Space Shuttle Photographed through the window of the space shuttle Challenger, the space craft's remote manipulator arm is shown with the Shuttle Pallet Satellite within its grasp. The Shuttle Pallet Satellite, built by the West German firm of Messerschmitt-Boelkow-Blohm, was involved in a launch and recovery experiment during the STS-7 mission on June 22, 1983.

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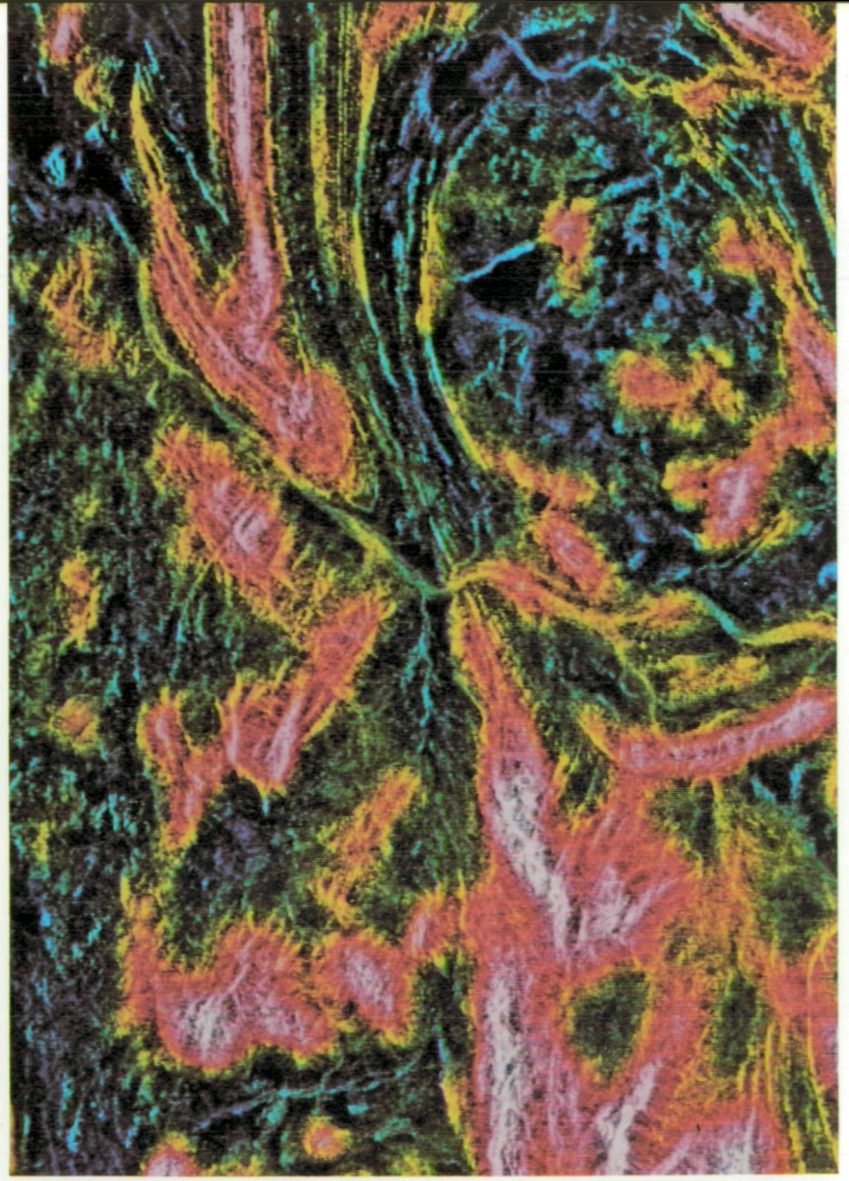

Radar Photo This colorful false-color photograph of the Hamersley Mountains in Western Australia was processed from data acquired by the Shuttle Imaging Radar-A, which operated aboard the second flight of the Space Shuttle Columbia from November 12-14, 1981. The radar was developed for NASA by the Jet Propulsion Laboratory of Pasadena, California. In this photo, the reds represent smooth areas, such as dry lakebeds. Faults in the landscape appear as thin lines. The image, which covers a 50 by 100-kilometer (31 by 62-mile) area, has recorded features which are about 1.5 billion years old and show a large central dome surrounded by eroded folds, indicating a volcanic past. The second Columbia mission, known as STS-2, was crewed by Astronauts Joe H. Engle and Richard H. Truly.

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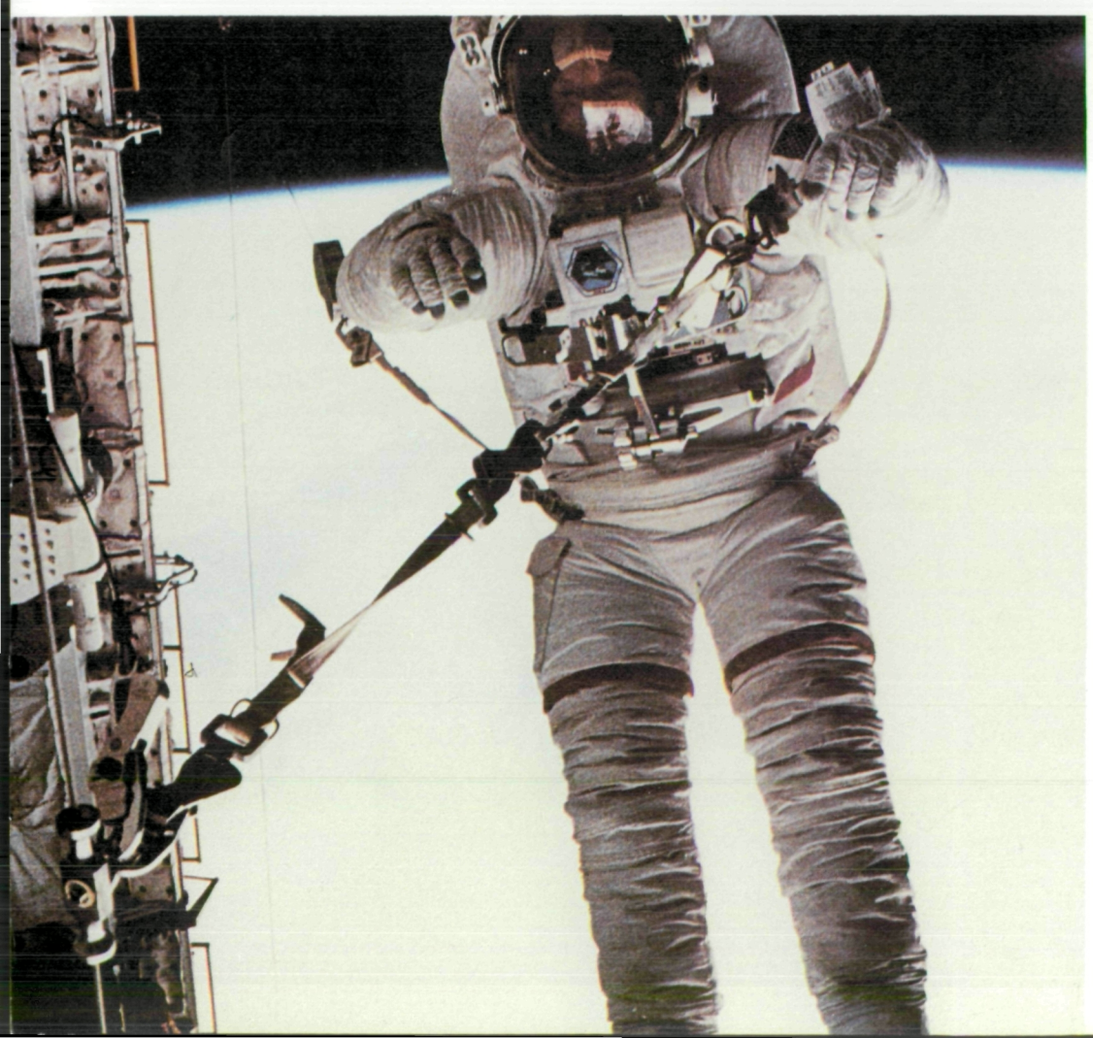

Outside of a Space Shuttle Astronaut F. Story Musgrave performs a safety tether dynamics checkout procedure on the outside of the Space Shuttle Challenger on April 7, 1983. The 35mm photograph of Musgrave was taken from the Challenger's cargo bay by Astronaut Donald H. Peterson. The STS-6 mission commenced on April 4 at the Kennedy Space Center at Cape Canaveral and concluded with a successful touchdown five days later at Edwards Air Force Base, California, on April 9.

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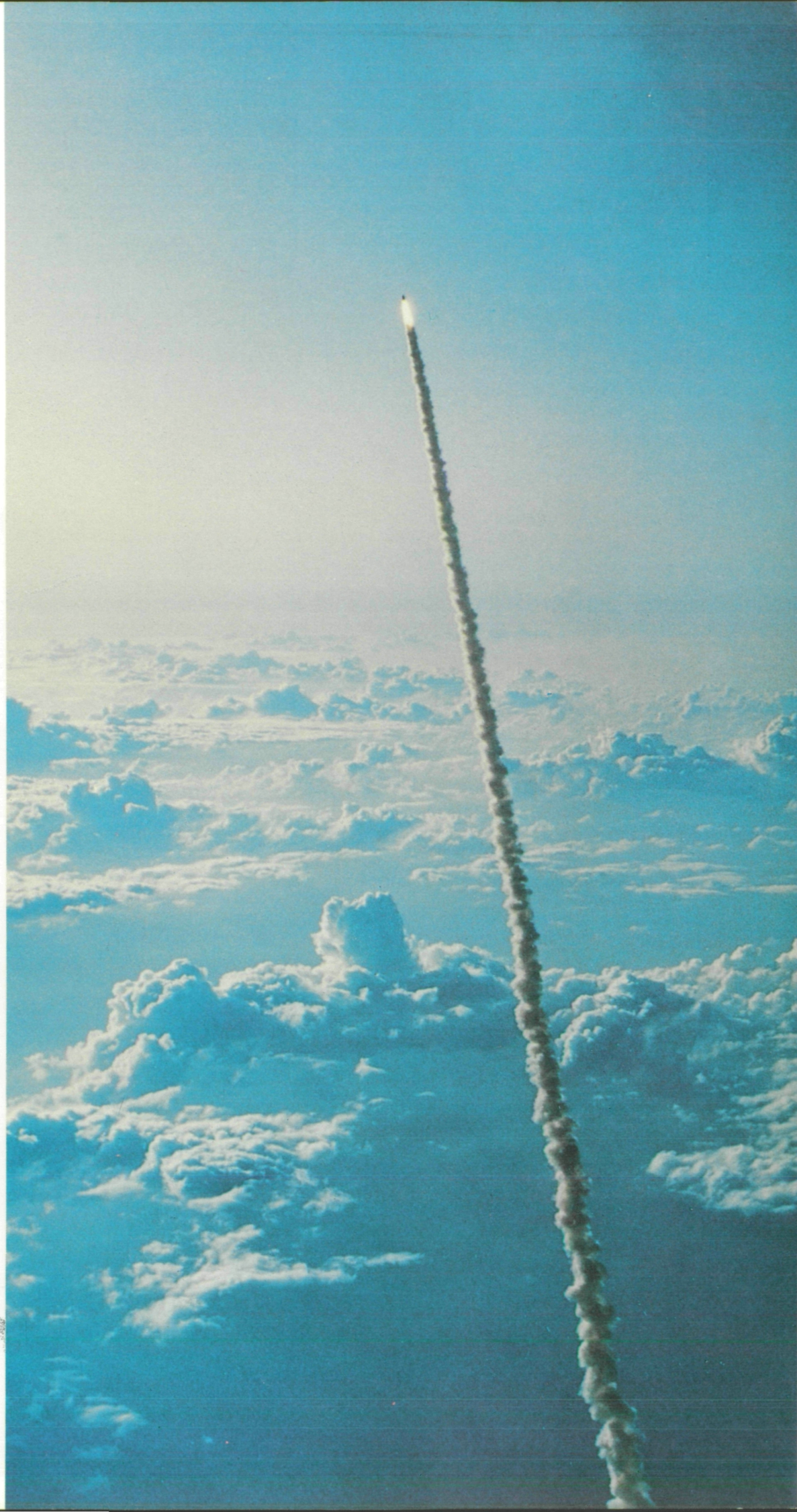

Space Shuttle in Flight
Seemingly suspended in the timelessness of space, the orbiter Challenger is shown in this photograph taken by a 70mm automatic camera from aboard the Shuttle Pallet Satellite that was launched by Challenger during the STS-7 mission. The camera took the first pictures of the shuttle in actual space flight. The picture was snapped on June 22, 1983, just two days before Challenger and its crew of five made a successful landing at Edwards Air Force Base, California.

Streaking Like a great spear being hurled into space the Space Shuttle Challenger races out of Cape Canaveral after its June 18, 1983 launch from the Kennedy Space Center. Astronaut John W. Young piloting a shuttle training aircraft recorded this scene with a handheld 70mm Hasselblad camera.

Successful Landing The space shuttle Columbia is shown in this photograph by Rene Burri on the Northrup Air Strip at the White Sands Test Facility in New Mexico after it successfully completed its third Earth orbital mission on March 30, 1982. The mission, known as STS-3, began at the Kennedy Space Center at Cape Canaveral on March 22, 1982, with astronauts Jack R. Lousma and C. Gordon Fullerton aboard. Columbia landed at White Sands, instead of its usual Edwards Air Force Base, California landing site, because heavy rains had drenched the area where the Space Shuttle would have touched down and it was felt that the soggy sand could not support the shuttle's weight. The major goal of STS-3 was thermal testing of the space vehicle. Also tested was the cargo manipulator arm.

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Space Shuttle Touchdown Kicking up a sand cloud on touchdown at Edwards Air Force Base, California, the space shuttle Columbia arrives home on April 14, 1981, after its first mission in space.

Escort for a Space Shuttle A motor vehicle convoy escorts the space shuttle Columbia to its parking place a few minutes after it touched down at Edwards AFB, CA, at dawn on November 16, 1982. The huge spacecraft, which had just completed America's fifth space shuttle mission, seems to dwarf the vehicles beside it, in this photo by Linda Richards.

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Space Shuttle Watchers The July 4, 1982 landing of the Space Shuttle Orbiter Columbia after the successful completion of its fourth mission is witnessed by President and Mrs. Reagan. The President is seen here with Astronauts Jack Lousma (far right) and Gordon Fullerton (second from right). To the right of the President and Mrs. Reagan are Astronaut Robert Crippen (far left) and NASA Administrator James M. Beggs (second from left). Astronaut Joe Engle appears over the President's right shoulder.

Shuttle Over Paris With the Eiffel tower jutting upward in the upper right of the photo, NASA's 747 space shuttle transporter dips low over Paris en route to the Paris Air show with the Enterprise cradled above it. Enterprise was NASA's first space shuttle orbiter. Although it never performed an actual mission, the results of its testing led to the successful missions of Columbia and Challenger.

Washington Monument and Space Shuttle The Washington monument and a portion of Washington's mall area are the backdrop for the space shuttle Enterprise on the morning of June 12, 1983, as the 747 transporter prepares for its final approach to Dulles International Airport, outside the capital. Enterprise was displayed that day at Dulles following a successful tour which included Europe, the United Kingdom, Iceland and Canada.

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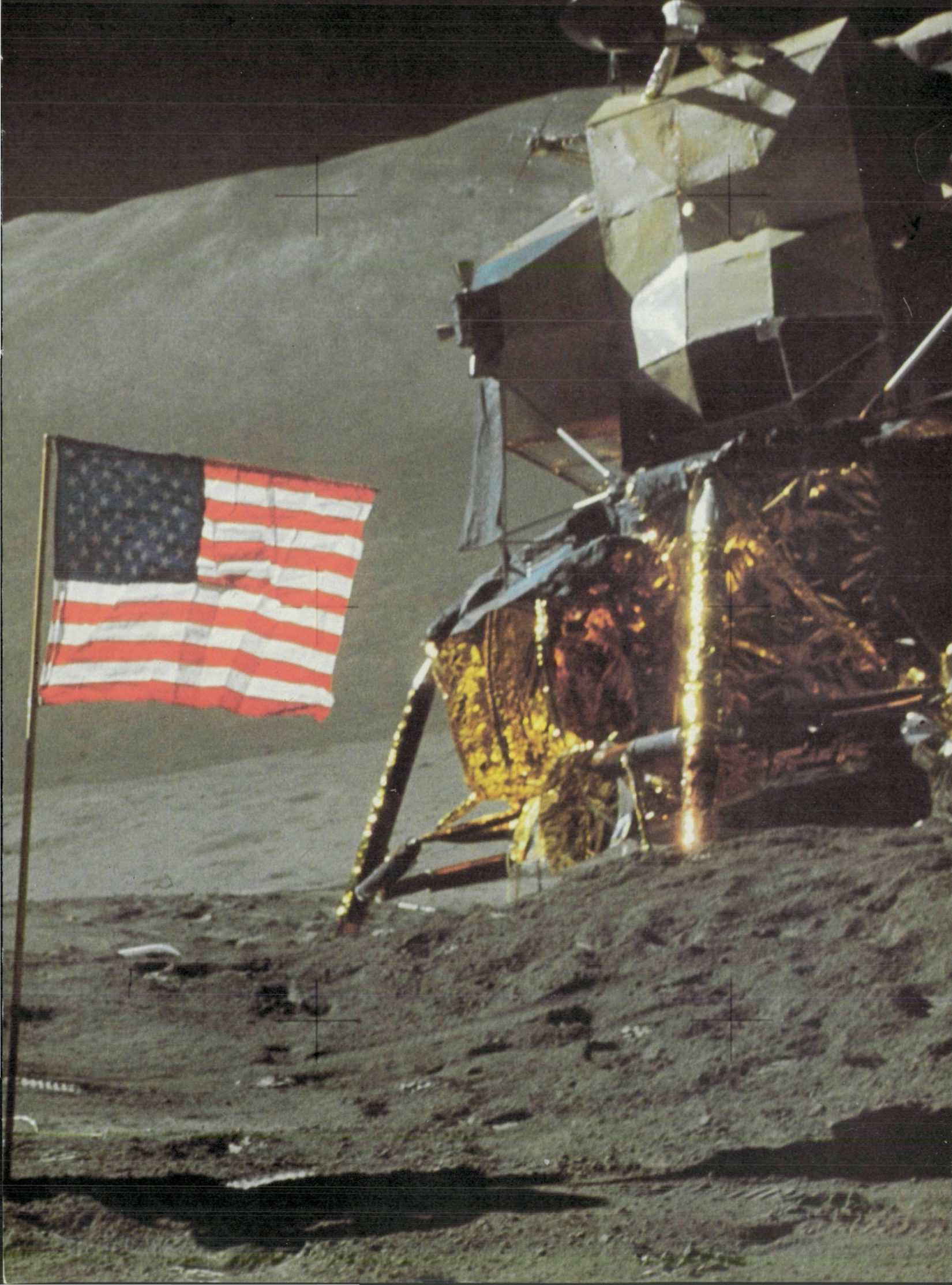
MANNED SPACE FLIGHT

On May 5, 1961, the United States became a serious challenger in space when Astronaut Alan B. Shepard, Jr. made a 15-minute suborbital flight along the Atlantic Test Range in his Freedom 7 space capsule. With that mission, Shepard became the first American to go into space. Then, on February 20 of the following year, an American went into Earth orbit for the first time, when Astronaut John H. Glenn, Jr. did three Earth orbits before splashing down in the Atlantic. Six years and five months later, on July 20, 1969, Astronauts Neil Armstrong and Edwin Aldrin, Jr. became the first people from Earth to walk on the Moon. America had overcome a wide lead in the space technology gap in little more than a decade.

The manned lunar landings, which ended with the Apollo 17 mission in December 1972, did not conclude American manned space activity. The Skylab missions of the Seventies, which demonstrated the feasibility of manned orbiting space stations, and the space shuttle flights of the Eighties, which have shown the utility of reusable spacecraft, are but the latest chapters in the on-going story at NASA of putting and sustaining people in space.

The possibilities for manned space flight are endless. Human exploration of the nearer planets is considered practical. The means to develop the technology to do so is in place now. The only limitations are those which we have not yet learned to overcome: The ordering of priorities and allocation of resources.

Americans On the Moon
Astronaut James B. Irwin salutes the U.S. flag beside the Lunar Module and the lunar rover during the Apollo 15 mission on the Moon. Irwin, with Astronaut David R. Scott, logged more than 18 hours of travel from the Lunar Module Falcon's base on the Marsh of Decay to the foothills of the Apennine Mountains.



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Webb and Dryden NASA Administrator James E. Webb (left) and deputy administrator Dr. Hugh L. Dryden listen to a presentation given to President Lyndon B. Johnson at NASA headquarters in February 1965. Webb, who served as administrator from February 1961 to October 7, 1968, helped America's space program go from short-distance suborbital flights to the threshold of the Moon.

America's First Astronauts Only six months after NASA was formally established on October 1, 1958, the first seven astronauts were announced for Project Mercury. Shown in the front row, left to right, are Walter M. Schirra, Jr., Donald K. Slayton, John H. Glenn, Jr., and Scott Carpenter. Shown left to right in the back row are Alan B. Shepard, Jr., Virgil I. "Gus" Grissom and L. Gordon Cooper.

Commitment to a Manned Moon Landing "I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to Earth." That goal, described by President John F. Kennedy in a historic speech before a joint session of Congress on May 25, 1961, was realized at 10:56 PM EDT on July 20, 1969, when Astronaut Neil A. Armstrong became the first human being to set foot on the Moon. Behind the President are (left) Vice-President Lyndon B. Johnson, and (right) Speaker of the House of Representatives Sam T. Rayburn.

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Bringing in an Astronaut At the end of a successful sub-orbital flight, Astronaut Alan B. Shepard, Jr. is reeled into a recovery helicopter on May 5, 1961. Just below the astronaut is the Freedom 7 capsule in which Shepard made a 15-minute sub-orbital flight over the Atlantic ocean after a flawless launch from Cape Canaveral atop a Mercury-Redstone-3 rocket. The flight was the first manned space flight in the program known as Project Mercury.

First Manned Space Flight On February 20, 1962, the world held its breath as Astronaut John H. Glenn, Jr., streaked into space in the Friendship 7 space capsule. In this fiery lift-off scene from Cape Canaveral, Glenn is being propelled toward Earth orbit by an Atlas rocket.

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Ready to Go Astronaut John H. Glenn, Jr., gives the ready sign to photographer Bill Taub during the pre-launch activities at Cape Canaveral. This picture was taken a month before Glenn's historic three-orbit trip around the Earth. On that day, Glenn's Friendship 7 space capsule was launched into orbit from the Cape and Glenn became the first American to go into Earth orbit. The five-hour mission ended with an Atlantic recovery.

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Walking in Space Gemini 4 astronaut Ed White goes for a walk in space directly over Sonora, Mexico. The photo of White tethered to the space capsule was taken by Astronaut James A. McDivitt. The Gemini 4 mission commenced on June 3, 1965, with a Titan II launch from Cape Canaveral. The mission was the first one in which an American walked in space. White and McDivitt were recovered from an Atlantic splashdown on June 7 after completing 22 Earth orbits.

To Rescue An Astronaut A Navy helicopter's rotor wash creates a lacy pattern on the ocean off Cape Canaveral, during a launch-abort rescue exercise. This photo was taken just prior to the May 15, 1963, Mercury 9 mission in which an Atlas rocket launched from Cape Canaveral put Astronaut L. Gordon Cooper into 22 Earth orbits aboard his Faith 7 spacecraft. The mission concluded with a Pacific recovery on May 16.

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Apollo 6 Liftoff A Saturn V launch vehicle carries an unmanned Command Module and Launch Escape Tower past the swung-back gantry arms during the test phase launch of Apollo 6. The automatic camera that made this photograph was mounted on the 108-meter (360-foot) level of the umbilical tower.

Fiery Launch of Apollo 6 The roaring rocket engines of the giant Saturn V launch vehicle create an inferno of fire and pulsating explosion as they push the Apollo 6 spacecraft past the umbilical tower. The cold liquid propellants used by the Saturn V create a coating of ice that "boils-off" during launch, in what appears as a layer of white smoke in the photo.

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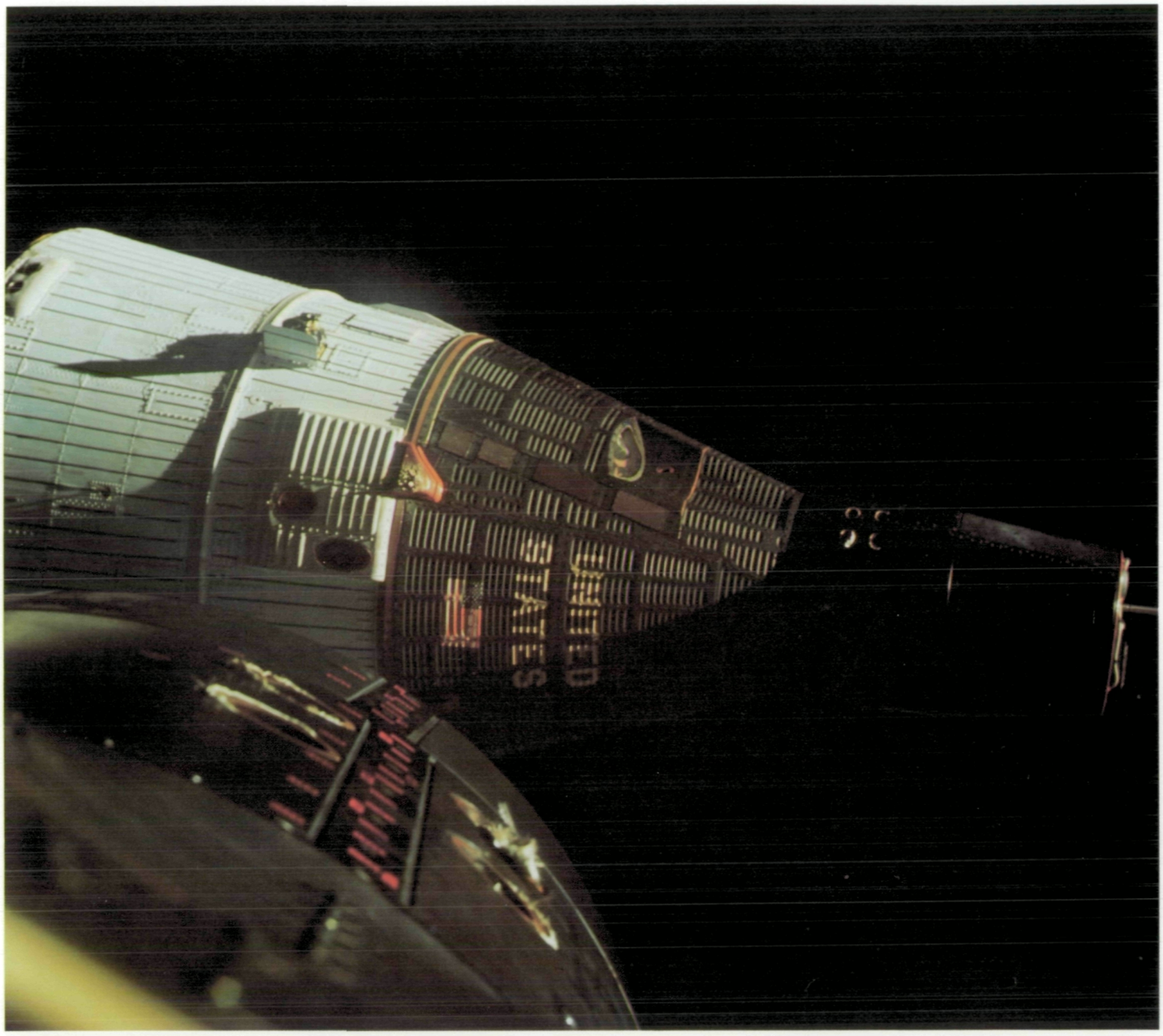

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Recovery Back from a successful Gemini 7 mission, Astronauts Frank Borman (right) and James A. Lovell, Jr., seem happy to be back after splash-down in the Western Atlantic on December 18, 1965. Gemini 7 was for that time a record-breaking, 14-day, 206-orbit mission in space. The two astronauts were photographed aboard the recovery vessel, the aircraft carrier USS Wasp. The Gemini 7 mission provided a rendezvous vehicle for the Gemini 6-A mission which was crewed by astronauts Walter M. Schirra and Thomas P. Stafford.

Closing In Astronauts Walter M. Schirra, Jr. and Thomas P. Stafford saw this view of the Gemini 7 space vehicle as they closed in for what became the first successful rendezvous in space with another vehicle. This photo was taken during the Gemini 6-A/7 missions, which accomplished the rendezvous on December 15, 1965, in Earth orbit. The two vehicles came within 2-meters (six feet) of each other and that position was maintained for 5½ hours. Gemini 6-A, which began at Cape Canaveral with a Titan II rocket launch on December 15, ended with an Atlantic recovery on December 16. The Gemini 7 vehicle was manned by astronauts James A. Lovell, Jr. and Frank Borman, who left the Cape on December 4 via a Titan II launch vehicle.

High Over West Africa The vast sandy stretches of the northeastern portions of the Sahara Desert, and the nations of Libya, Chad, Nigeria and Algeria, have been captured in this photo taken during Gemini 11 mission which commenced on September 12, 1966, via a Titan II launch vehicle from Cape Canaveral. During that mission, Astronauts Charles Conrad, Jr., and Richard F. Gordon, Jr., did 44 Earth orbits and successfully linked up with an Agena target docking vehicle, which was launched into space from the Cape by an Atlas-Agena rocket on the same day as the astronauts. The mission ended on September 15 with an Atlantic recovery.

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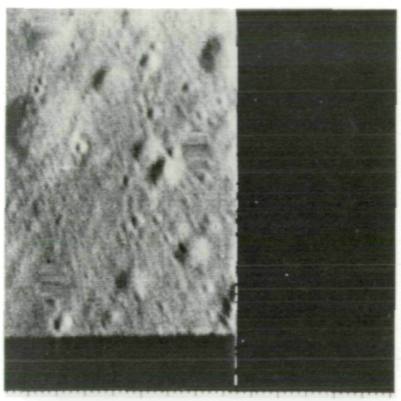
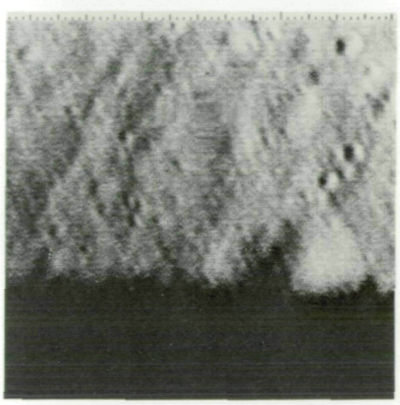
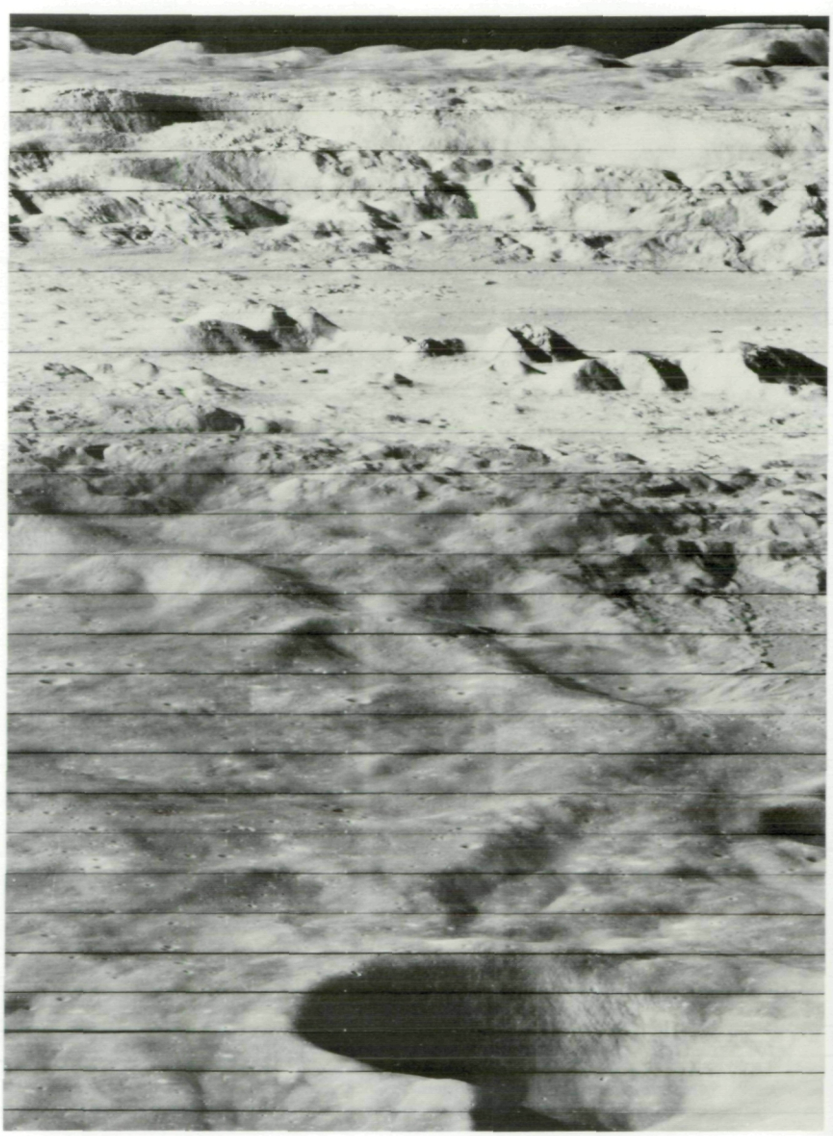




Lunar Impact The top photograph is the last picture transmitted to Earth by the Ranger 7's camera before the unmanned lunar probe crashed down on the Moon's surface on July 31, 1964. The impact came before the full photo could be sent, which is why the frame is incomplete. Ranger 7 was launched by an Atlas-Agena rocket on July 28 from Cape Canaveral. At the time, the pictures it transmitted before its hard impact with the Moon were considered to have a 1000-fold increase in resolution over the best Earth-based Moon photos.

The Picture of the Century That's what scientists exclaimed when the telephoto lens of the camera on Lunar Orbiter 2 transmitted this photograph of the floor of the crater Copernicus to Earth on November 28, 1966. Copernicus is 60 miles in diameter and two miles deep. Seen from the Earth, it dominates the upper left quadrant of the Moon.

Moon Scape Surveyor 7's TV camera transmitted this stark moonscape scene on January 9, 1968. The unmanned lunar probe came to rest approximately 18 miles north of the crater Tycho after a successful soft landing. Surveyor 7 was launched by an Atlas Centaur rocket from the Kennedy Space Center at Cape Canaveral on January 7, 1968.



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Splashdown A Navy frogman got this photograph of Astronaut John Young being pulled from his Gemini 10 spacecraft after an Atlantic splashdown on July 21, 1966. The splashdown scene was some 7½ miles from the primary recovery ship, the USS Gaudalcanal. Young, and Astronaut Michael Collins did 43 Earth orbits and performed the first successful docking in space with another vehicle, an Agena target vehicle which was launched on July 21, 1966, from Cape Canaveral by an Atlas rocket.

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Preparation for a Manned Lunar Landing Astronauts Edwin Aldrin (left) and Neil Armstrong are shown in this fish-eye photograph inside the lunar module simulator at the Johnson Space Center in Houston, Texas. The astronauts are seen preparing for the historic Apollo 11 mission, the first manned lunar landing, which put them on the Moon on July 20, 1969.

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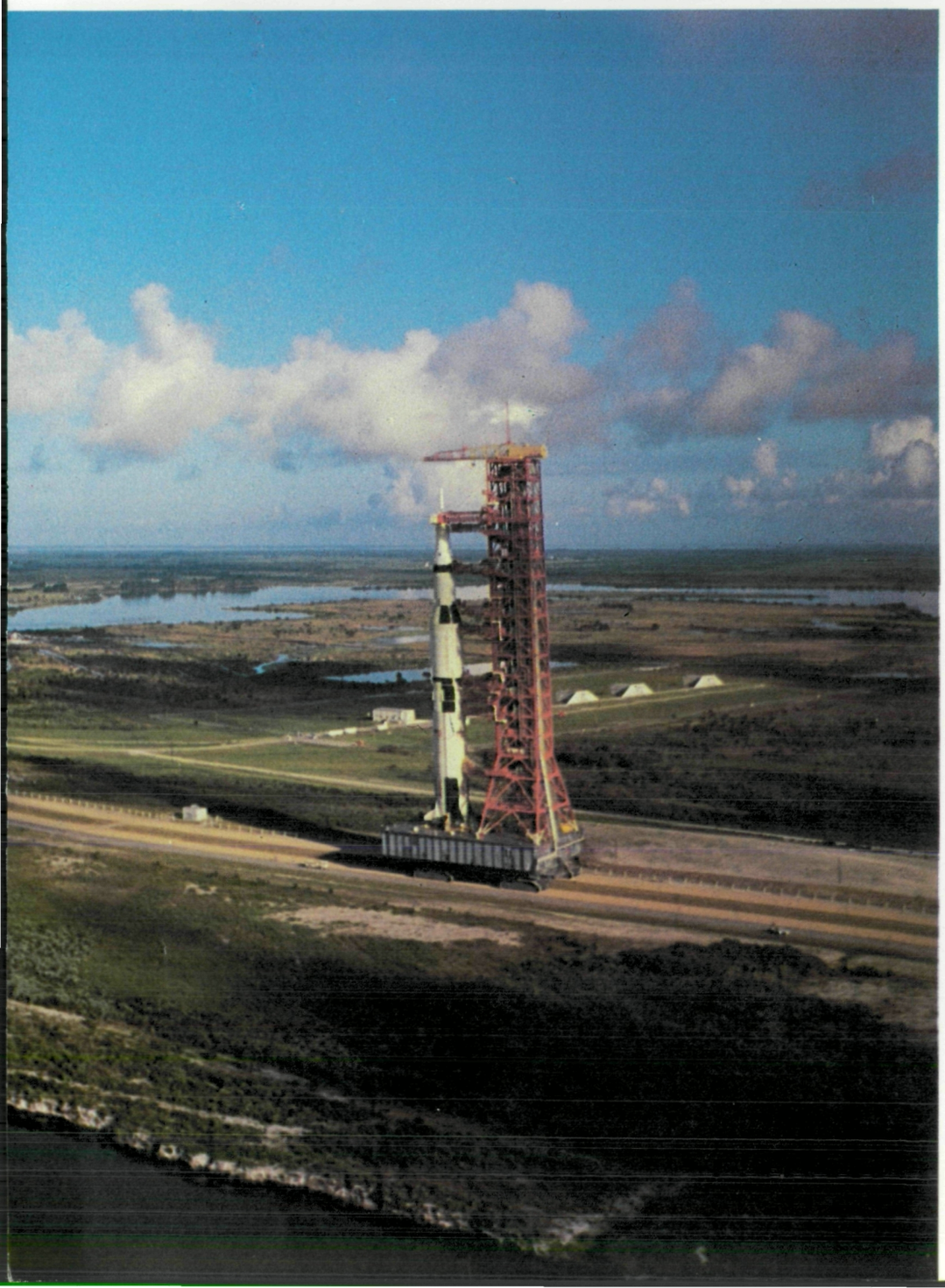

Catching an Agena Gemini Astronaut Charles Conrad, Jr., took this photo of his mission partner, Astronaut Richard F. Gordon, Jr., attaching a tether line to the Agena target docking vehicle while in Earth orbit approximately 160 nautical miles above the Atlantic Ocean. The Gemini 11 astronauts successfully carried out rendezvous and docking experiments with the target docking vehicle which had been launched separately on the same day, using an Atlas-Agena launch vehicle.

Moving Toward a Launch Date This panoramic view of a portion of the Kennedy Space Center at Cape Canaveral, shows a Saturn V rocket en route from the Vehicle Assembly Building, shown at left, to its launch pad. The Saturn V, which weighs 6,286,000 lbs when fueled, is being transported to its launch pad on a mobile launcher, and is traveling over a crawlerway designed to support loads as high as 18 million pounds. On November 9, 1967, this vehicle was launched on the Apollo 4 unmanned Earth orbital mission which tested heat shields at lunar re-entry speeds.

Apollo 17 Night Launch
December 7, 1972, the last mission to the Moon, leaves Cape Canaveral, Florida for an historic journey to Taurus-Littrow on the surface of Earth's legendary satellite. After a stay of 75 hours on the lunar surface the crew of Apollo 17 returned to Earth with 243 lbs. of lunar samples and a new appreciation of our universe.

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Earthrise Parts of Africa, Europe, North and South America can be seen through the blue haze of Earth rising over the Moon's surface in this striking photo taken from the Apollo 8 manned spacecraft in lunar orbit. Apollo 8 was the first manned Saturn V flight. It left the Kennedy Space Center at Cape Canaveral on December 21, 1968, via a Saturn V launch vehicle with Astronauts Frank Borman, James A. Lovell, Jr., and William A. Anders; and accomplished ten lunar orbits.

Ill-Fated Astronauts Astronauts (left to right) Virgil Grissom, Edward White and Roger Chaffee were the only fatalities in all of America's space missions. On January 27, 1967, the three died in an Apollo spacecraft fire during pre-launch activities at Cape Canaveral. The astronauts were preparing for an Apollo/Saturn 204 Earth orbital mission scheduled for February of that year.

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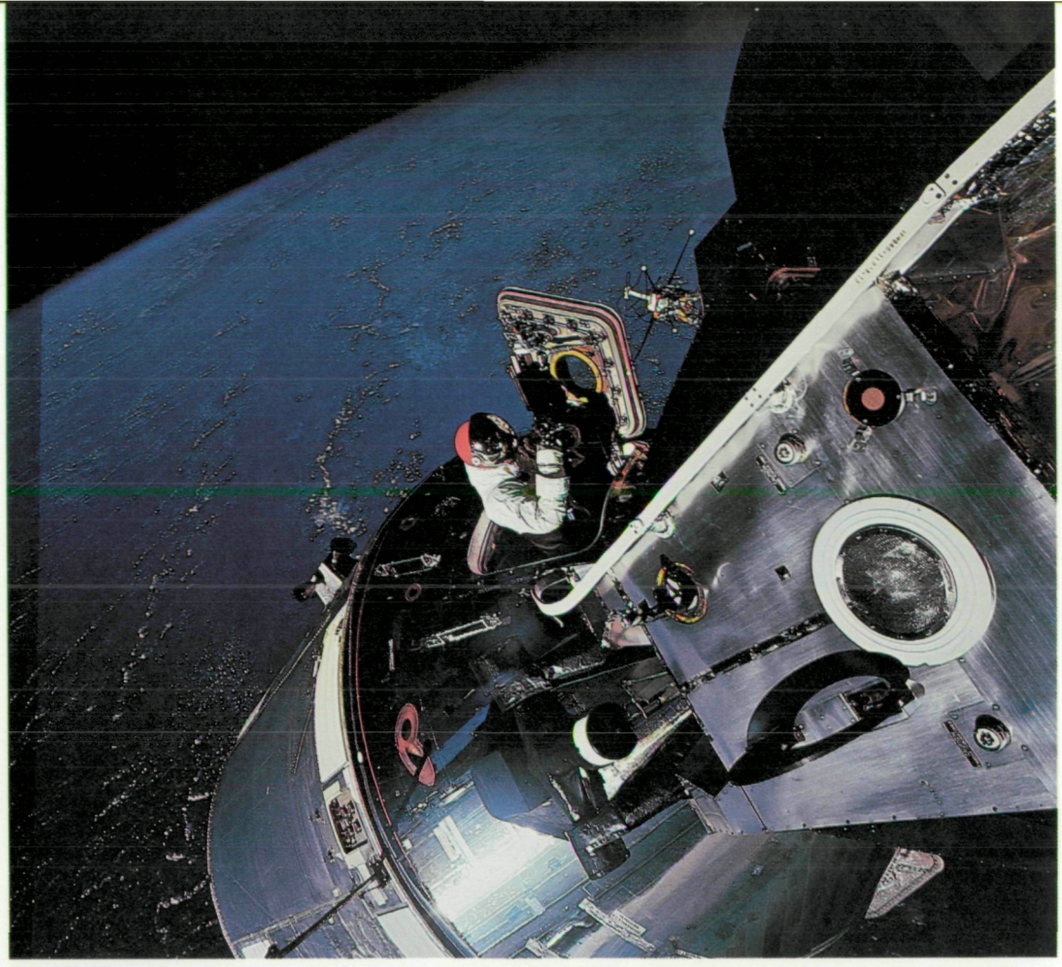

Orbital View While in Earth orbit, Astronaut David R. Scott stands in the hatch of the Apollo 9 command module and gets set to photograph Astronaut Russell L. Schweickart, who took this dramatic scene during an extra-vehicular activity. The command module was launched on March 3, 1969, by a Saturn V rocket from the Kennedy Space Center at Cape Canaveral. Scott, Schweickart and Astronaut James McDivitt were in Earth orbit for over 241 hours during which time they tested all of the manned lunar mission equipment.

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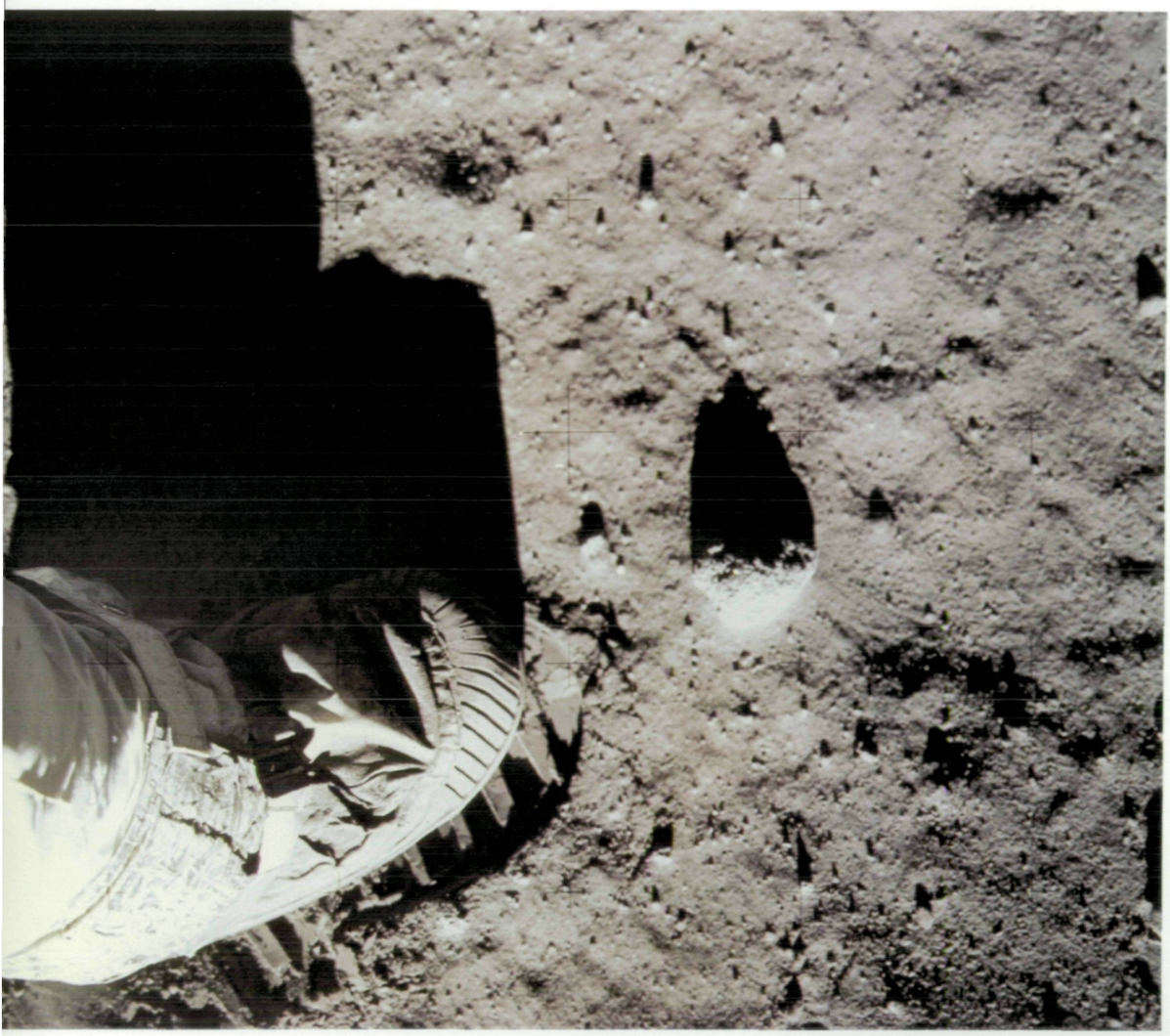
Saturn S-IVB Stage High over the Gulf of California in Earth orbit, Apollo 7 astronauts Walter M. Schirra, Donn F. Eisele and Walter Cunningham saw this view of the Saturn S-IVB stage with which they rendezvoused to within 70 feet. The S-IVB Saturn stage came from the same Saturn 1B rocket which sent the Apollo 7 astronauts into space from the Kennedy Space Center at Cape Canaveral on October 11, 1968, for docking and maneuvering exercises. The white disk on the left side of the vehicle's spherical surface is used as a docking target.



A First Step on the Moon Just after Apollo 11 Astronaut Neil Armstrong took his first steps on the Moon, he took this historic photograph of his own boot upon the lunar surface. Armstrong first set foot on the Moon on July 20, 1969, along with Astronaut Edwin Aldrin. The landmark space mission began at the Kennedy Space Center at Cape Canaveral with a Saturn V launch on July 16, and concluded with a Pacific recovery on July 24.

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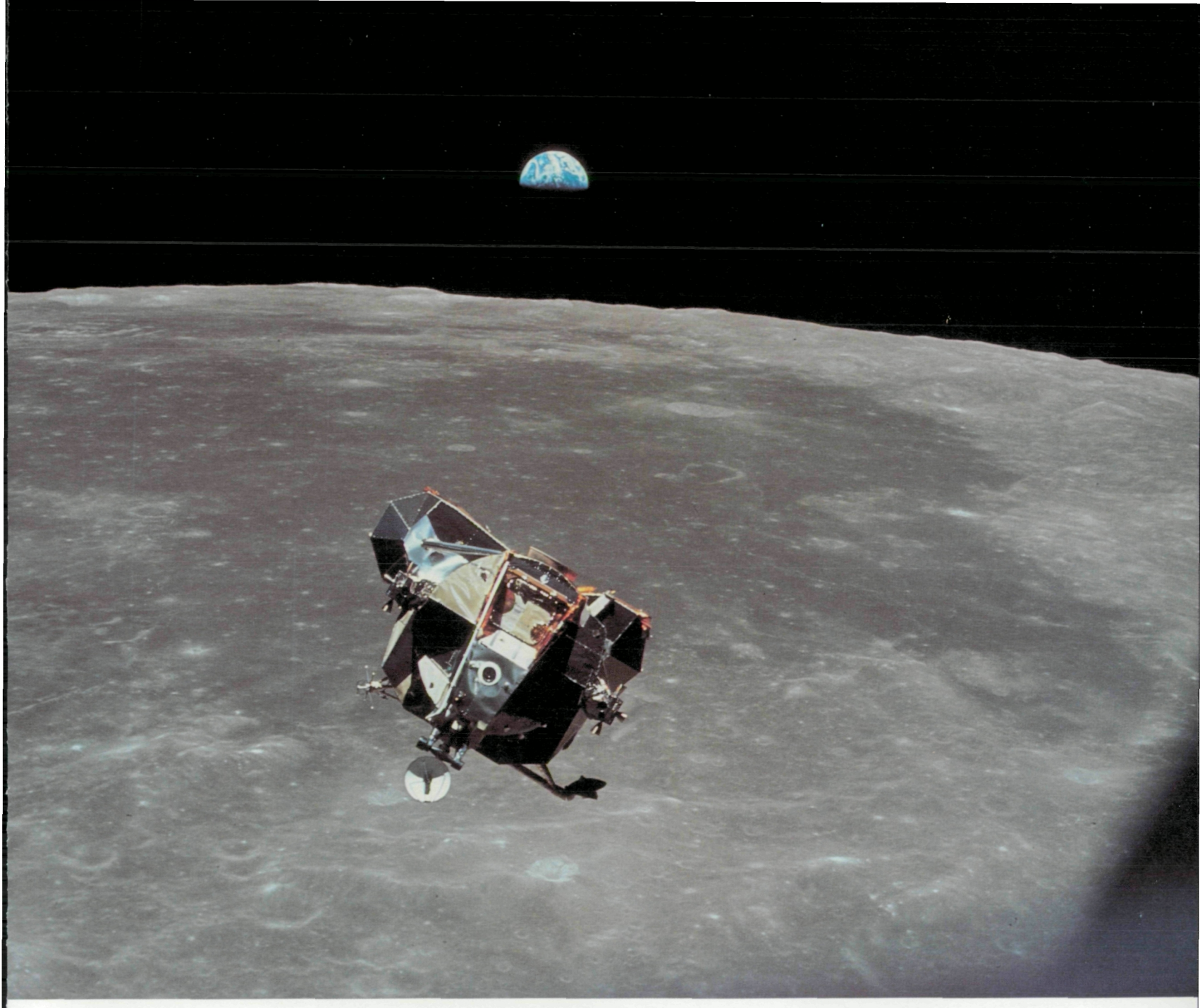
Old Glory on the Moon Astronaut Edwin Aldrin contemplates the American flag in this photo taken by Astronaut Neil Armstrong on the Moon's surface during the Apollo 11 mission, which put a human being on the Moon for the first time. The lunar landing module is visible to the left.



Ascent from the Moon Orbiting the Moon in the Apollo 11 command module, Astronaut Michael Collins took this striking photograph of the lunar lander rising from the Moon's surface with Astronauts Edwin Aldrin and Neil Armstrong. In this picture, the lunar landing vehicle is about to rendezvous and dock with the command module which will take all three astronauts back to Earth for the successful conclusion of America's first manned lunar landing. A half-Earth can be seen rising beyond the lunar horizon.

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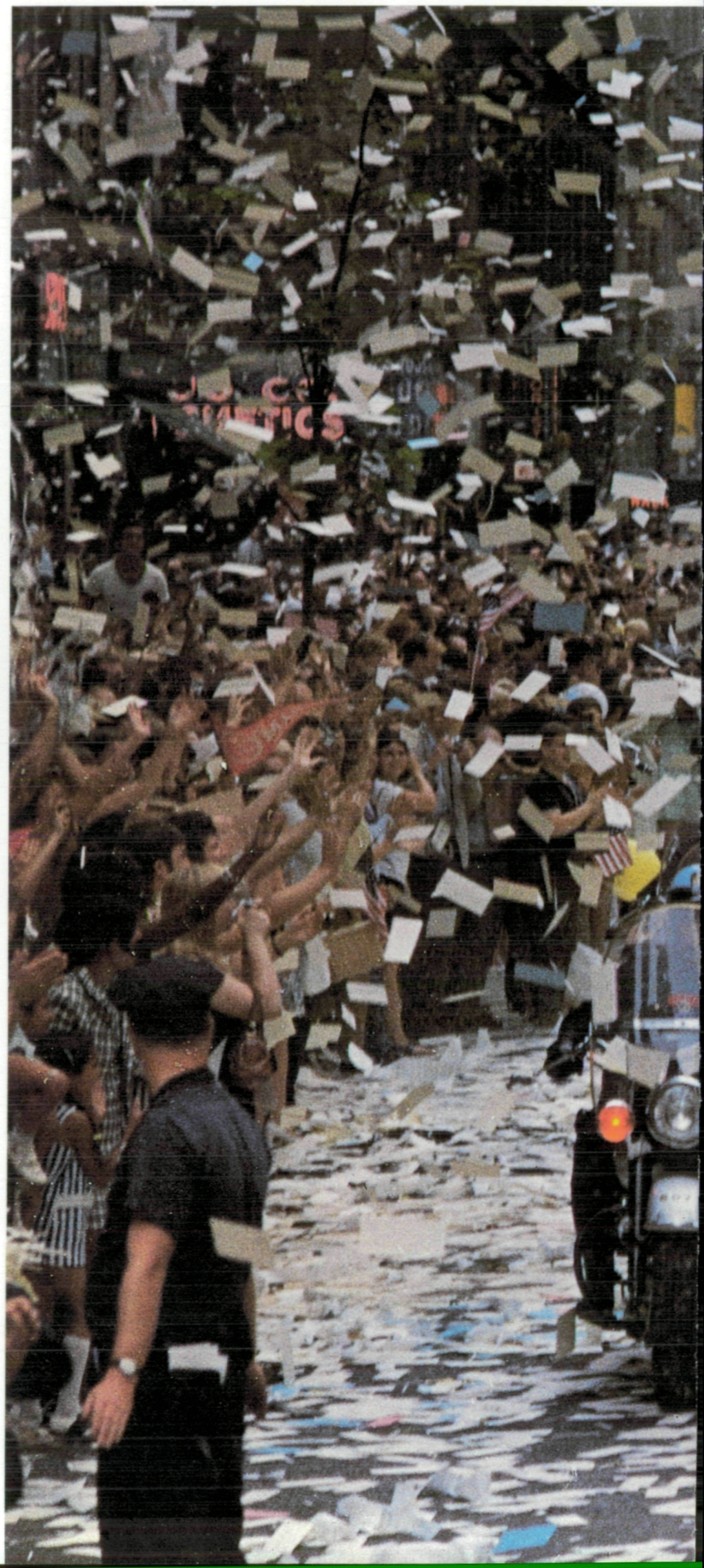
A Hero's Welcome Apollo 11 Astronauts Edwin Aldrin, Michael Collins and Neil Armstrong stand in an open car as throngs of New Yorkers welcome them in an August 13, 1969 parade, which was estimated to be the largest in the city's history.

A Presidential Welcome President Richard M. Nixon greets astronauts (left to right) Neil A. Armstrong, Michael Collins and Edwin E. Aldrin, Jr., on July 24, 1969, four days after Armstrong and Aldrin walked on the Moon, and just after they splashed down in the Pacific 900 miles southwest of Hawaii. The Apollo 11 Astronauts are shown within their quarantine trailer aboard the USS Hornet.



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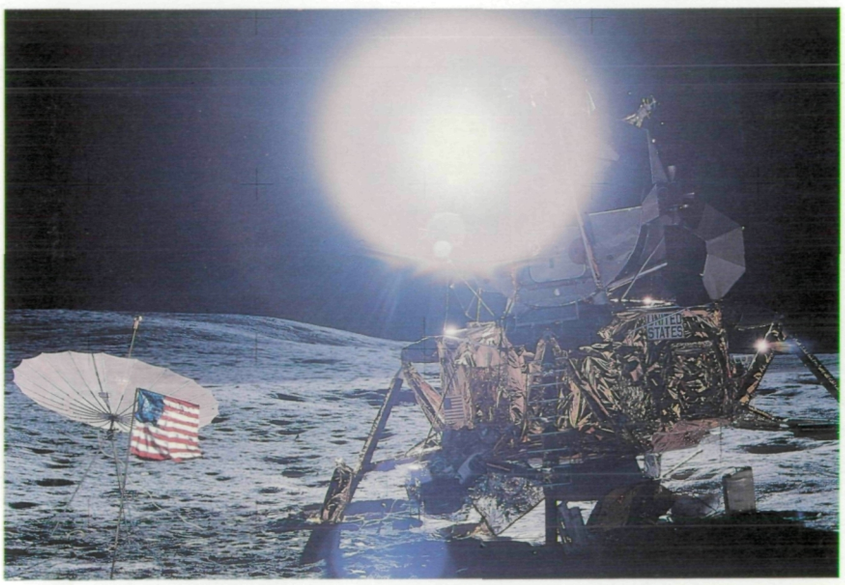
Reflection on the Moon Apollo 12 Astronaut Charles Conrad, who took this picture, is reflected in Astronaut Alan Bean's EVA visor as the two astronauts explore the lunar surface. Bean and Conrad touched down on the Moon on November 19, 1969, on America's second manned lunar landing mission. Astronaut Richard Gordon was the Command Module Pilot.



Sunbathed Moon The Sun's golden disk illuminates the Moon's surface in this photograph of the Apollo 14 lunar module, which appears to be sheathed in gold. An S-band transmission antenna, and the American flag indicate the presence on the lunar surface of Astronauts Alan B. Shepard, Jr., and Edgar D. Mitchell. Shepard, Mitchell and Astronaut Stuart Roosa, who piloted the command module in lunar orbit, left the Kennedy Space Center at Cape Canaveral atop a Saturn V rocket on America's third manned Moon landing mission, January 13, 1971.

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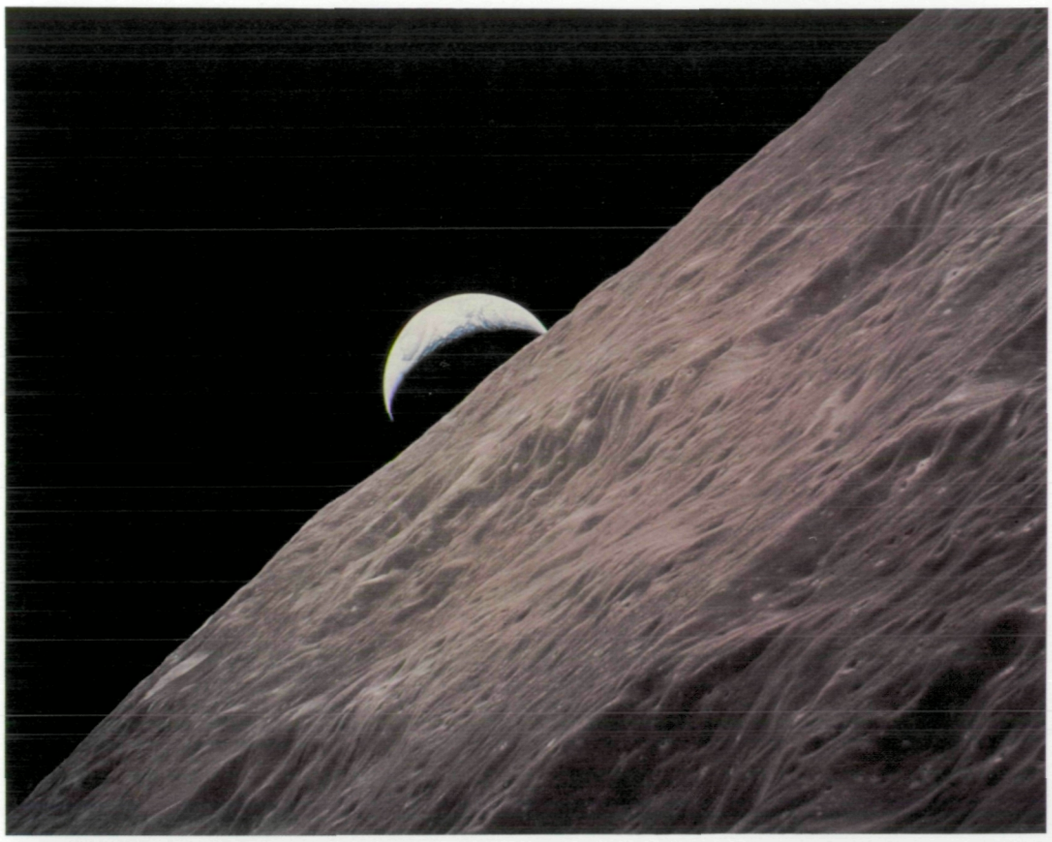
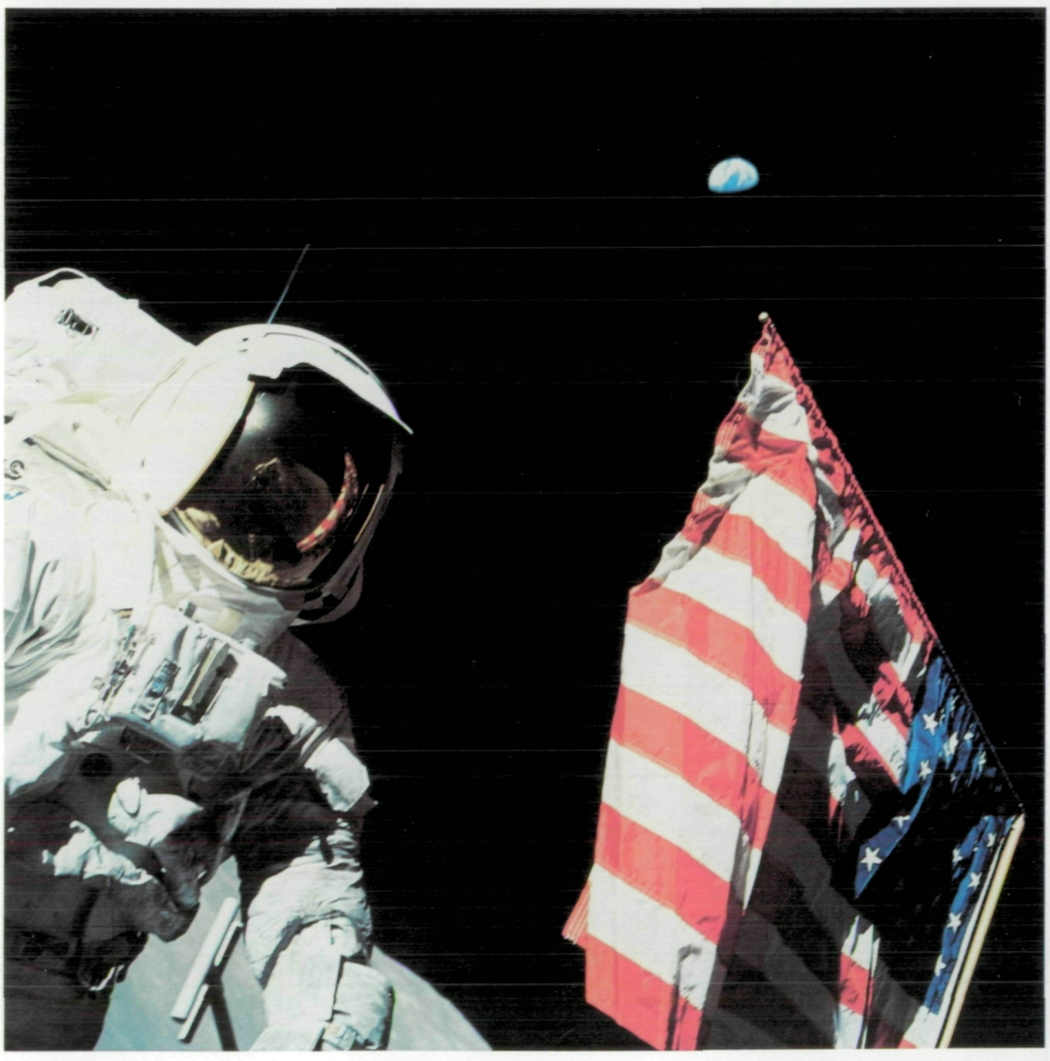
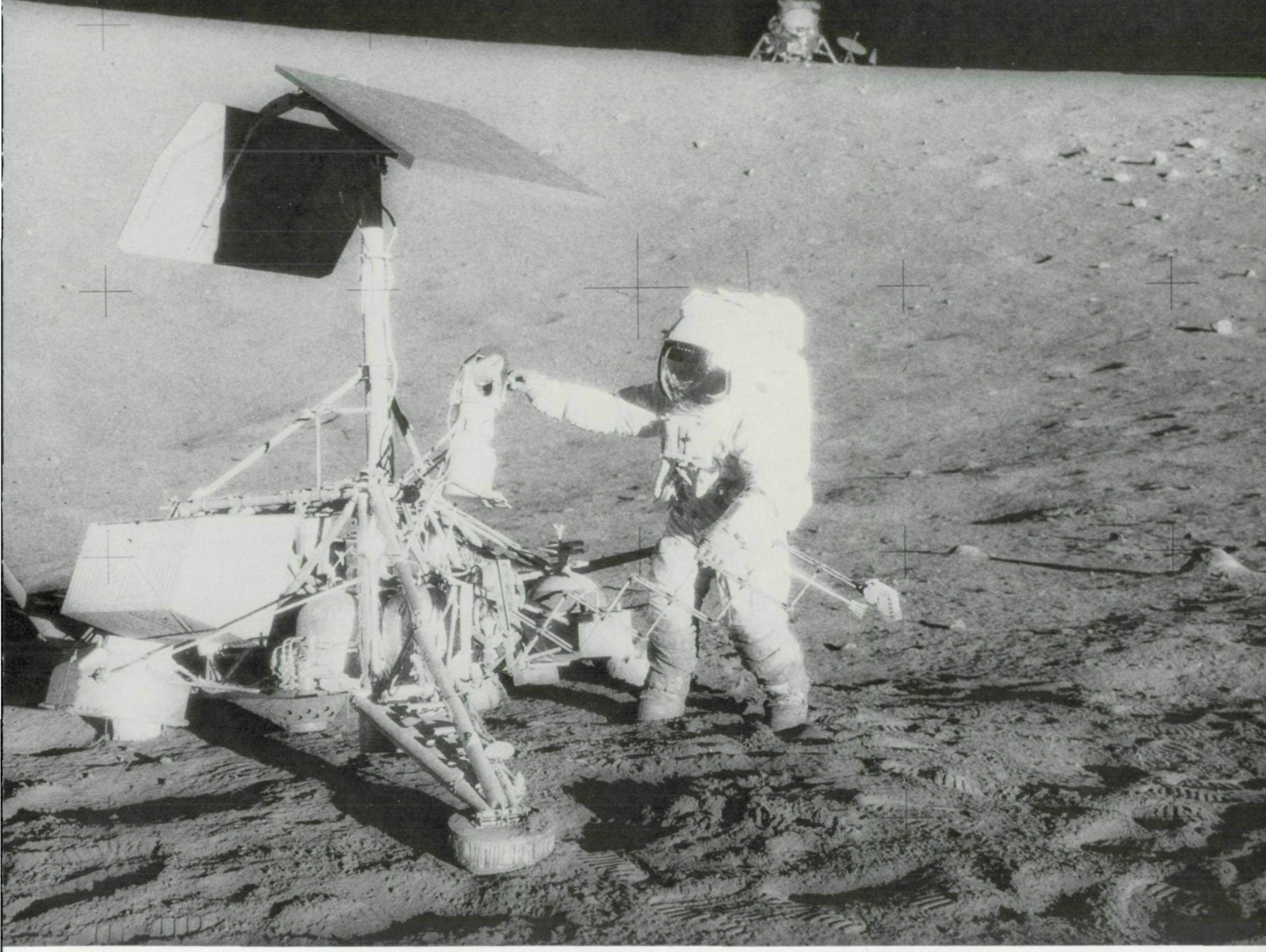


Earthrise Over The Moon Apollo 17 astronauts photographed the Earth coming up over the lunar horizon in this spectacular photo taken from the Apollo Command Module.



Astronaut and the Flag Apollo 17 Astronaut Eugene Cernan took this photograph of Astronaut Harrison Schmitt beside the American flag on the Moon's surface. Apollo 17, which was America's last manned lunar landing, left the Kennedy Space Center on December 7, 1972 and returned to Earth on December 19th. In this picture, the Earth appears as a blue pearl in space just beyond the edge of the flag.



Apollo Meets Surveyor Apollo 12 Astronaut Charles Conrad examines the television camera on the Surveyor 3 spacecraft, which had been on the Moon since April 1967. The unmanned Surveyor 3 once transmitted over 6,000 pictures of the lunar landscape to Earth. The photo of Conrad and Surveyor 3 was taken by Astronaut Alan Bean who, along with Conrad, made America's second manned lunar landing on November 19, 1969. The Apollo 12 lunar landing vehicle is visible in the background.

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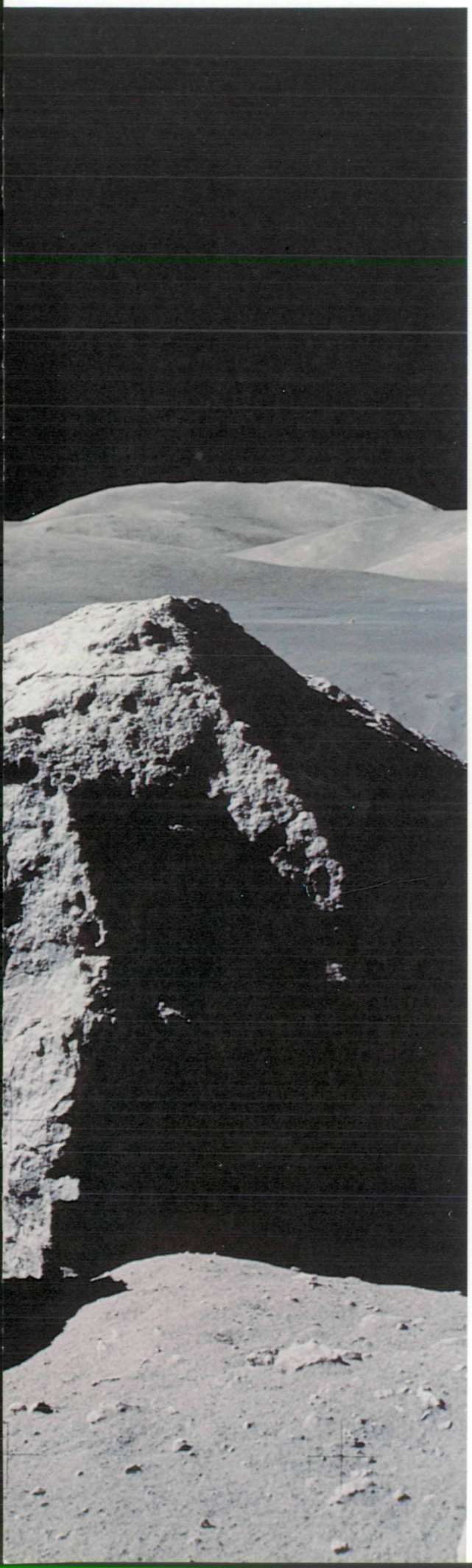

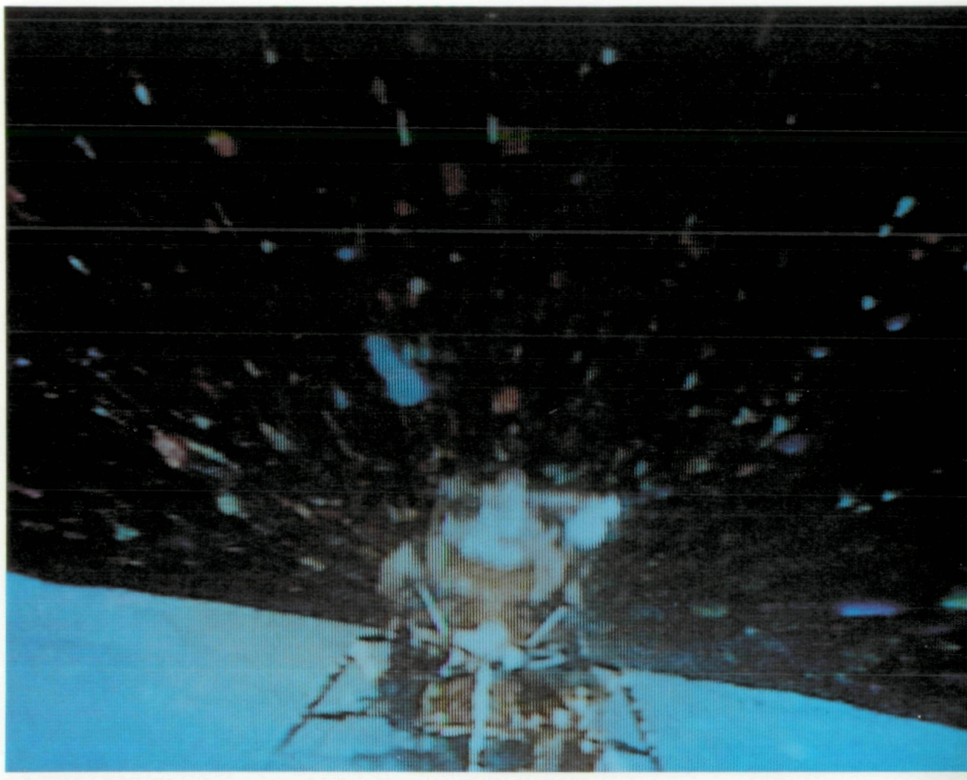

Exploring the Moon Apollo 17 Astronaut Eugene Cernan photographed Astronaut Harrison Schmitt beside this large lunar surface feature that has been dubbed "Splitrock." Astronaut Ronald Evans was in the command module circling overhead in lunar orbit.

Lunar Liftoff With a shower of sparks and lunar debris, the Apollo 16 lunar module "Orion" launches from the Moon's surface with Astronauts John W. Young and Charles M. Duke onboard. Astronaut Thomas K. Mattingly II awaited rendezvous and link-up with the Orion in the command module which was in lunar orbit. This colorful photo was transmitted to Earth by a television camera mounted on the lunar roving vehicle.

Apollo 13 Debriefing
Dr. Donald K. Slayton, Director of Flight Crew Operations, talks with Dr. Werner von Braun (right), famed rocket expert, at an Apollo 13 post-flight debriefing session. The three crewmen of the problem-plagued mission (left to right) in the background are James A. Lovell, Jr., Commander; John L. Swigert, Jr., Command Module Pilot; and Fred W. Haise, Jr., Lunar Module Pilot.

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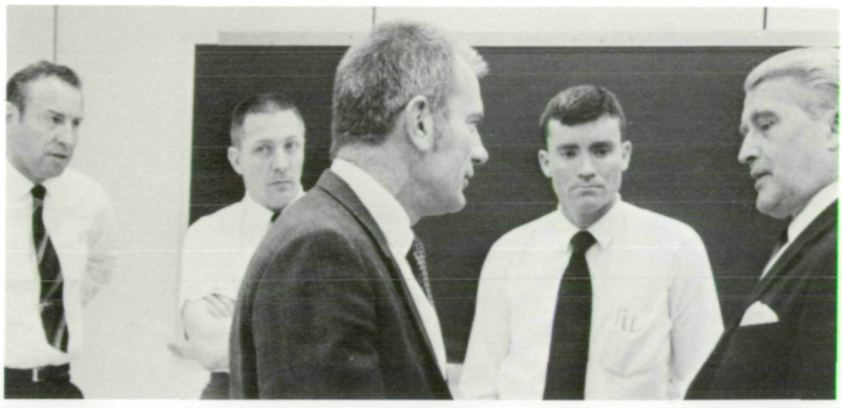

Innovative Life Saver
Dr. Donald K. Slayton displays prototype of a device improvised to remove carbon dioxide from the Apollo 13 Command Module when it became apparent the space craft's lithium hydroxide system was not removing it sufficiently. Manned Spacecraft Center members looking on (from left to right) are Milton L. Windler, Shift 1 Flight Director; Slayton, Howard W. Tindall, Deputy Director, Flight Operations; Sigurd A. Sjoberg, Director, Flight Operations; Dr. Christopher C. Kraft, Deputy Director; and Dr. Robert R. Gilruth, Director.

"Houston, we've got a problem"
Apollo 13 was 207,000 miles from Earth and moving away at 2,100 miles an hour when the crew was startled by a loud bang. A liquid oxygen or hydrogen tank had ruptured seriously damaging

the Apollo 13 Service Module. The emergency triggered the procedures that grew into an effort by hundreds of ground controllers and thousands of technicians and scientists in NASA contractor plants and on university campuses to solve the most complex and urgent problem encountered in space flight.

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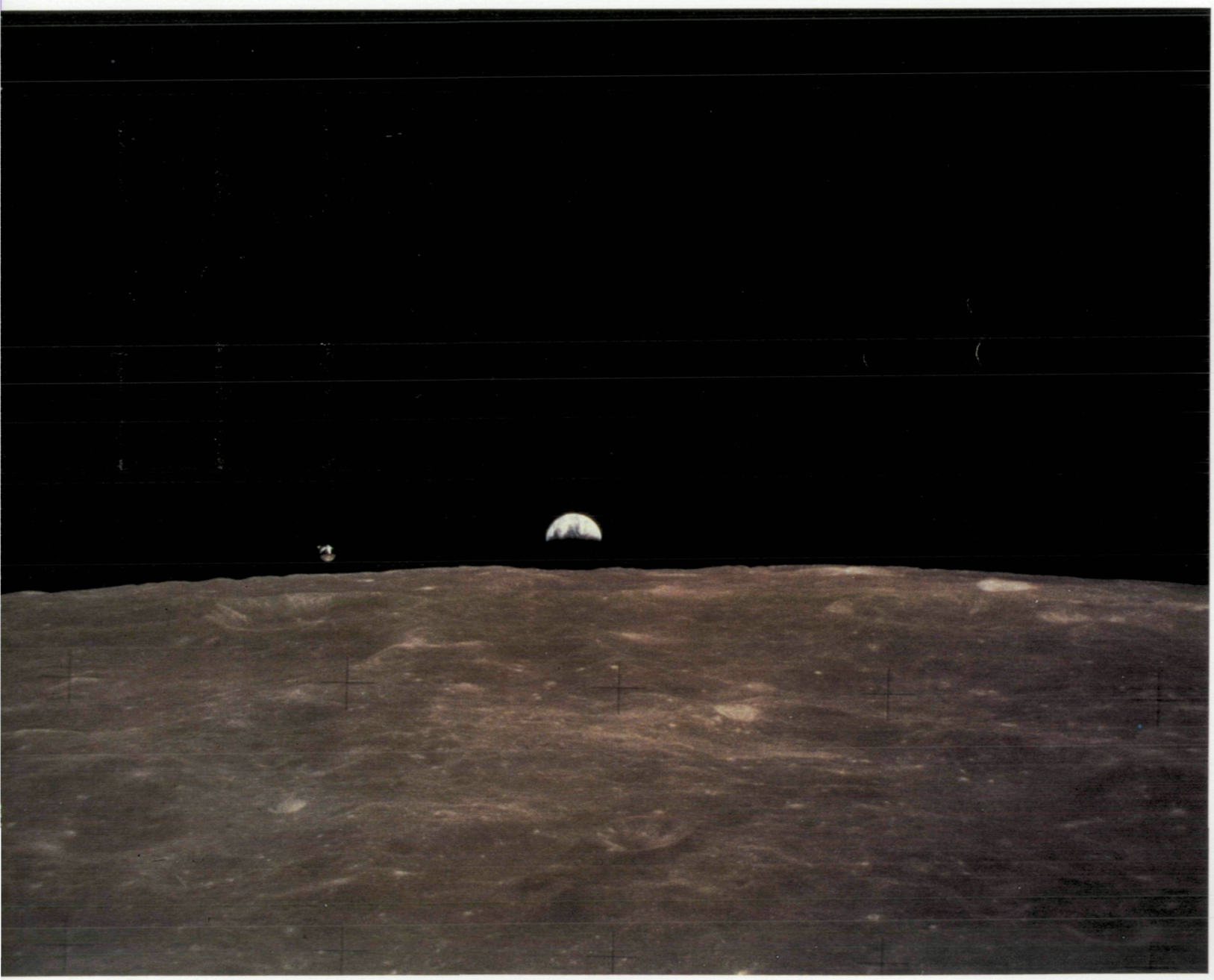
Probing for a Lunar Module The Earth rises, and just above the edge of the lunar horizon is Apollo 16 Astronaut Thomas K. Mattingly II's command module awaiting rendezvous and link-up with Astronauts John W. Young and Charles M. Duke, who took this picture from their lunar landing craft just after leaving the Moon's surface. Astronauts Young and Duke just spent over 71 hours on the Moon's surface.

Splashdown Red and white parachutes billow above blue Pacific waters at the moment of splashdown for Apollo 15 astronauts David R. Scott, James B. Irwin and Alfred M. Worden. In this photo, taken by photographer Victor Rhoder from a Navy helicopter, the wake around the Apollo spacecraft is still sharply discernable. The splashdown, which successfully concluded America's fourth manned lunar landing attempt, occurred more than 300 miles north of Hawaii on August 7, 1971.



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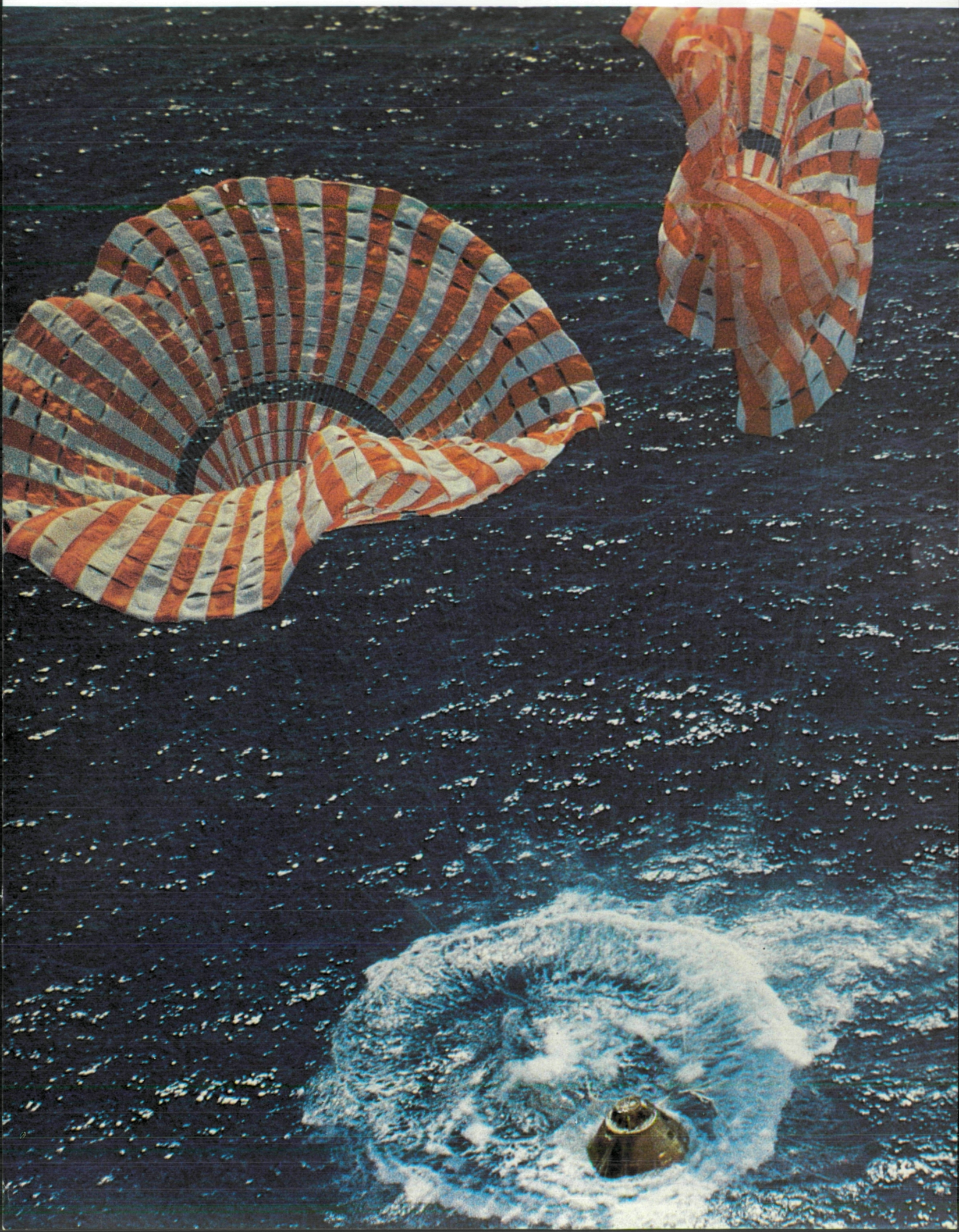

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Apollo Meets Soyuz Once rival competitors in the race for the first manned Moon landing, the United States and the Soviet Union participated in one joint space project, the Apollo-Soyuz Test Project. This photo, taken from the Apollo spacecraft, shows the Soviet Soyuz vehicle in Earth orbit just prior to the rendezvous and docking of the two vehicles on July 17, 1975. Linked in Earth orbit for two days, Astronauts Thomas P. Stafford, Vance D. Brand, and Donald K. Slayton visited Soviet Cosmonauts Valeriy N. Kubasov and Aleksey A. Leonov. The American astronauts began the historic mission from the Kennedy Space Center at Cape Canaveral aboard a Saturn IB rocket on July 15 and splashed down in the Pacific on July 24. The Soviet cosmonauts left Baykonur in the Soviet Union on July 15 using an A-2 launch vehicle and returned to a Kazkhstan recovery area on July 21.

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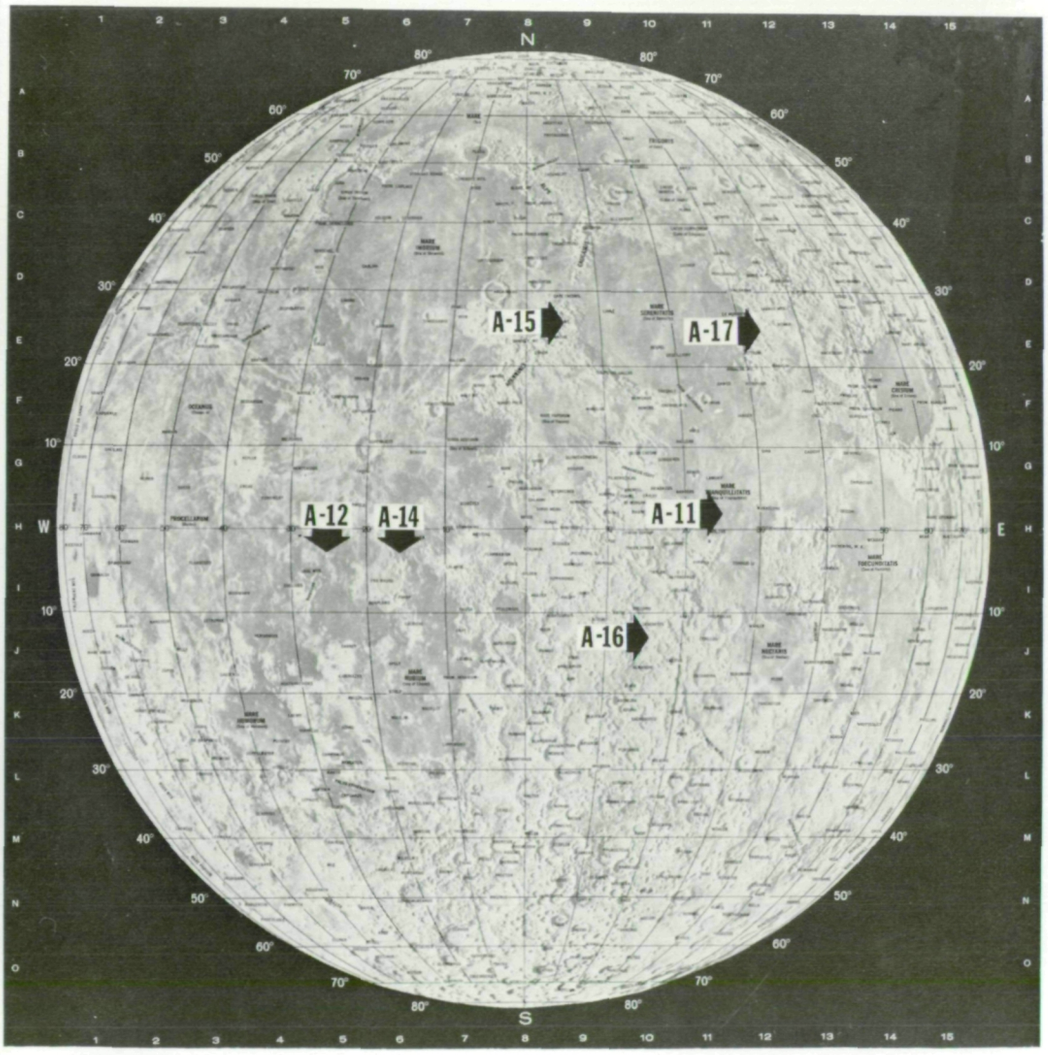
Greater Los Angeles This view of the Los Angeles area on a smog-free day was taken from the Apollo spacecraft during the joint United States-Soviet Union Apollo-Soyuz Test Project.

Moon Landings This map of the Moon indicates the places where the six successful Apollo manned lunar landings took place. All of the landings occurred on the side of the Moon visible to the Earth. The in-orbit and lunar surface experiments performed by the Apollo missions have functioned as a key to questions on the formation and history of our solar system, including tangible evidence on the evolution of our planet Earth.



Apollo 11
Launch date July 16, 1969
Astronauts Aldrin, Armstrong and Collins
Landed in the Sea of Tranquility (00.6° N Latitude/23.5° E Longitude)

Apollo 12
Launch date November 14, 1969
Astronauts Bean, Conrad and Gordon
Landed in the Ocean of Storms (03.0° S Latitude/23.4° W Longitude)

Apollo 14
Launch date January 31, 1971
Astronauts Mitchell, Roosa, and Shepard.
Landed at Fra Mauro (03.7° S Latitude/17.5° W Longitude)

Apollo 15
Launch date July 26, 1971
Astronauts Irwin, Scott and Worden
Landed at Hadley-Apennine (26.1° N Latitude/17.5° E Longitude)

Apollo 16
Launch date April 16, 1972
Astronauts Duke, Mattingly and Young
Landed at Descartes (09.0° S Latitude/15.5° E Longitude)

Apollo 17
Launch date December 1972
Astronauts Cernan, Evans and Schmitt
Landed at Taurus-Littrow (20.0° N Latitude/30.0° E Longitude)

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Skylab in Orbit Looking like a giant dragon fly, Skylab is seen in Earth orbit over the Amazon River just before astronauts Alan Bean, Owen Garriott and Jack Lousma rendezvoused and docked with America's first manned Earth orbiting space station. The astronauts who took this picture were on the Skylab 3 mission, which began with a launch of a Saturn 1B rocket from the Kennedy Space Center at Cape Canaveral on July 28, 1973.

Mobile Bay Area In this photo taken from Skylab space station in Earth orbit, an Earth resources camera traces the flow of the Mobile River and its sediment-laden currents into Mobile Bay.

A Walk Around Skylab
Astronaut Jack Lousma is pictured while performing an extra-vehicular activity during the 59 days that he and Astronauts Alan Bean and Owen Garriott participated in the Skylab 3 mission. They remained aboard until September 25 for a total of 59 days and performed systems and operational tests. They returned to Earth with a Pacific Ocean recovery.

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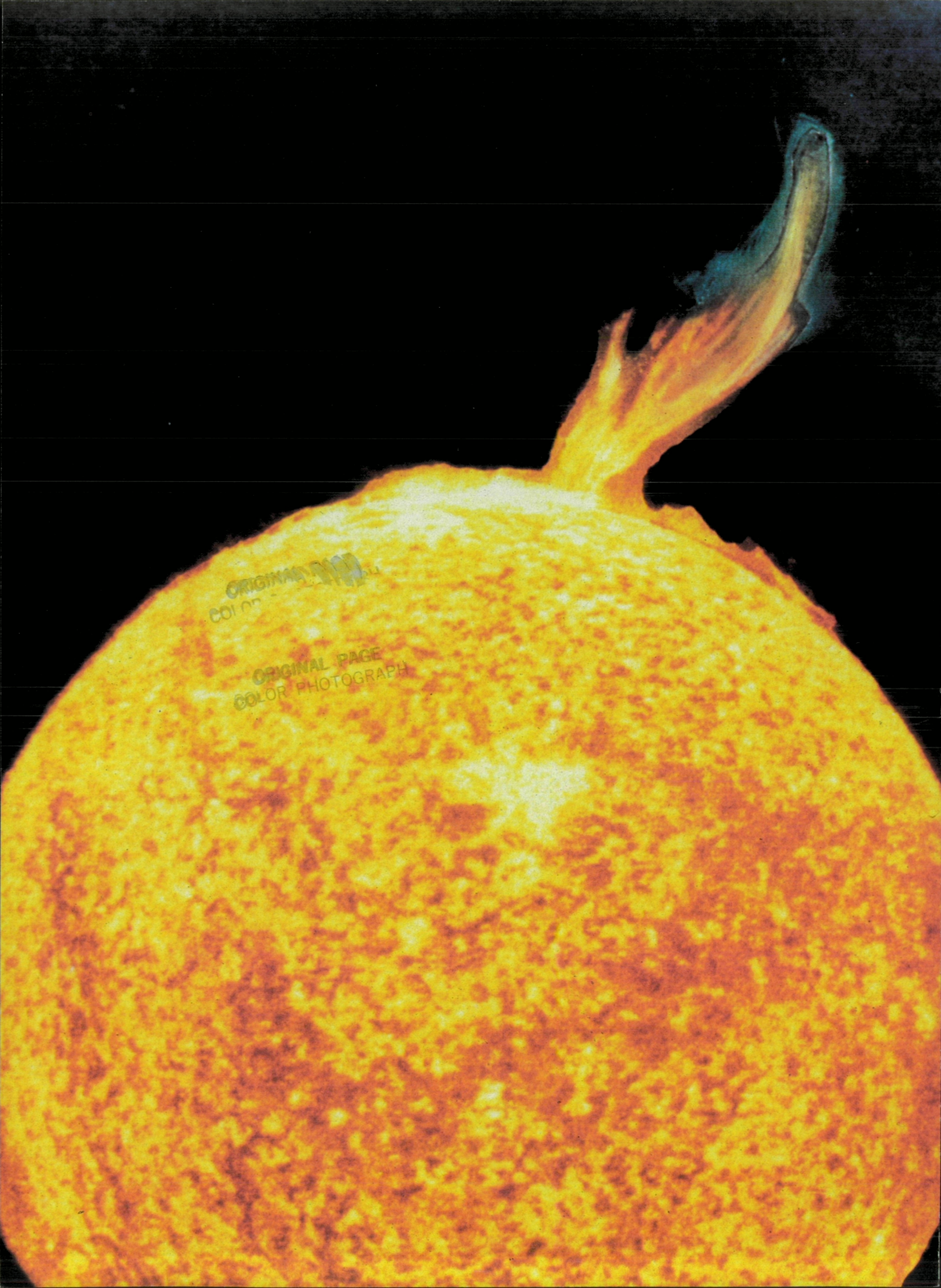
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Solar Flare The solar telescope of Skylab took this fiery scene showing a huge coronal transient flaring from the surface of the Sun. Skylab remained in Earth orbit for more than six years during which time three separate crews of astronauts visited the space station, spending a total of 171 days onboard. The unmanned, spent Skylab disintegrated upon re-entry into the Earth's atmosphere on July 11, 1979, after 34,981 orbits.

Spiral Cloud Cover Astronauts Alan Bean, Owen Garriott and Jack Lousma saw and photographed the South Pacific island of Guadalupe and these cloud vortices during the Skylab 3 mission.

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Pacific Ocean View Sunlight gives a silvery cast to the Pacific Ocean and clouds south of Hawaii in this scene which Apollo 11 Astronauts Neil Armstrong, Edwin Aldrin and Michael Collins saw just after their Saturn V launch vehicle inserted them into lunar trajectory.

Apollo View of Earth Apollo 8 Astronauts Frank Borman, James A. Lovell, Jr., and William A. Anders returned with this photo of the Earth from space, the first photograph of its kind actually taken by a human being. This mission, the first manned interplanetary Saturn flight, ended on December 27 with a Pacific splashdown, after 147 hours and ten Moon orbits.

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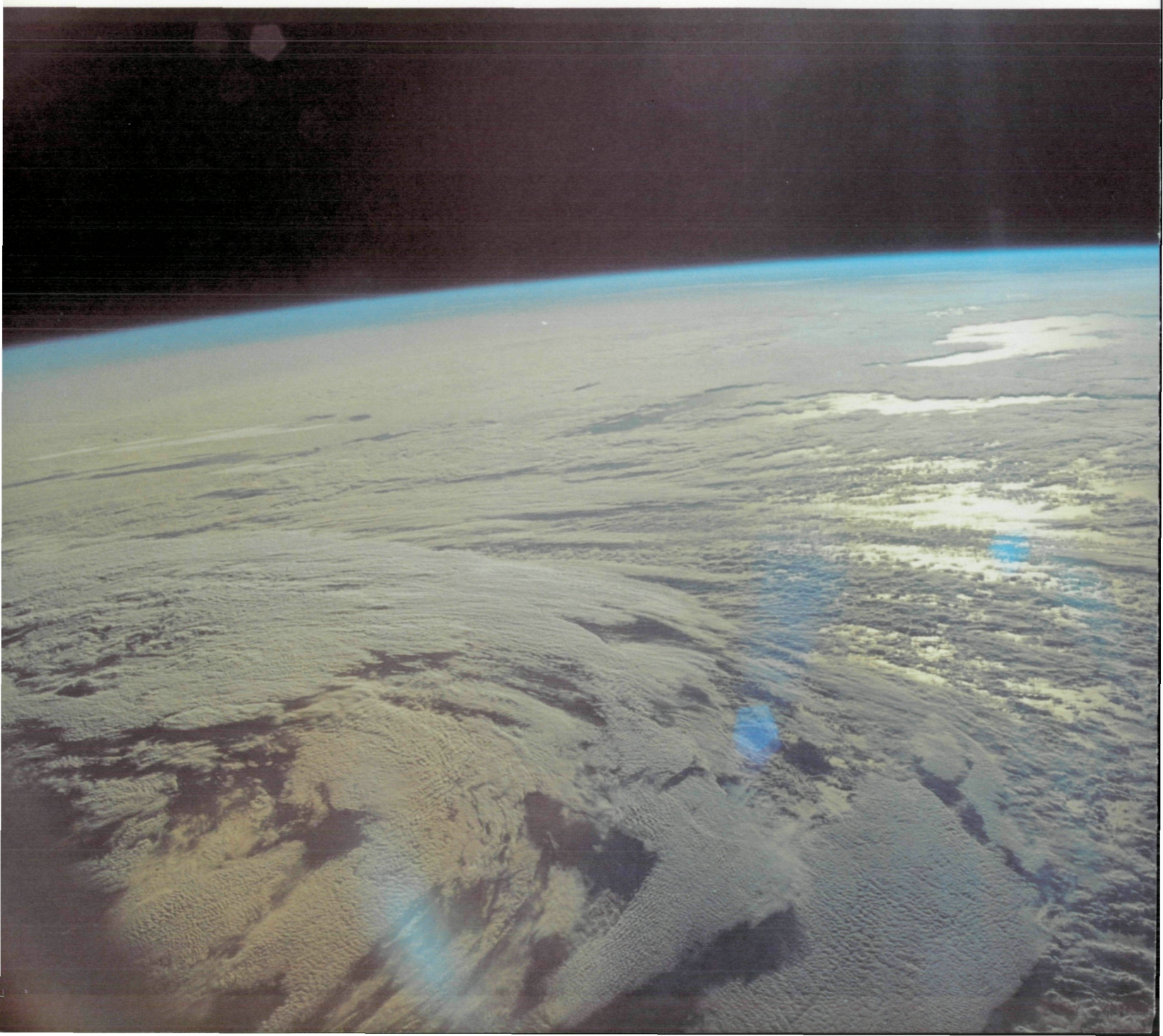

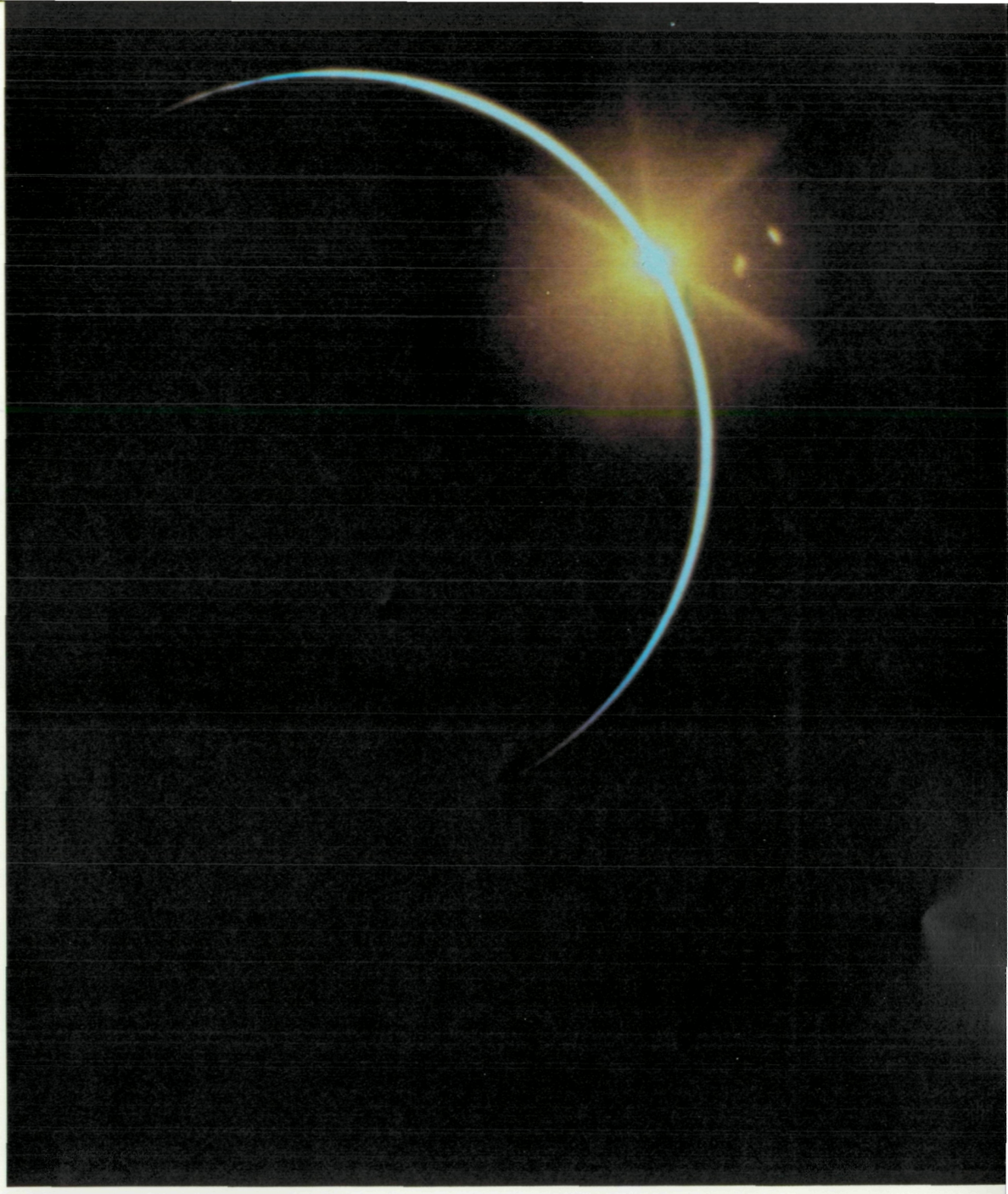

Eclipse With the appearance of a diamond ring on black velvet, the Earth moves in front of the Sun to make this striking eclipse scene photographed from space by an Apollo 12 astronaut. When this photo was taken, Astronauts Charles Conrad, Richard F. Gordon, and Alan L. Bean were enroute to the Moon and America's second manned lunar landing.

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Cobra Head An automatic metric camera affixed to the Apollo 15 command module took this photograph of two lunar ridges known as the Cobra Head, as the spacecraft passed some 70 statute miles above the lunar surface. Apollo 15 was the nation's fourth manned lunar landing. Astronaut Alfred M. Worden piloted the command module in lunar orbit and activated the camera, while Astronauts James B. Irwin and David R. Scott were spending nearly 67 hours on the Moon's surface.

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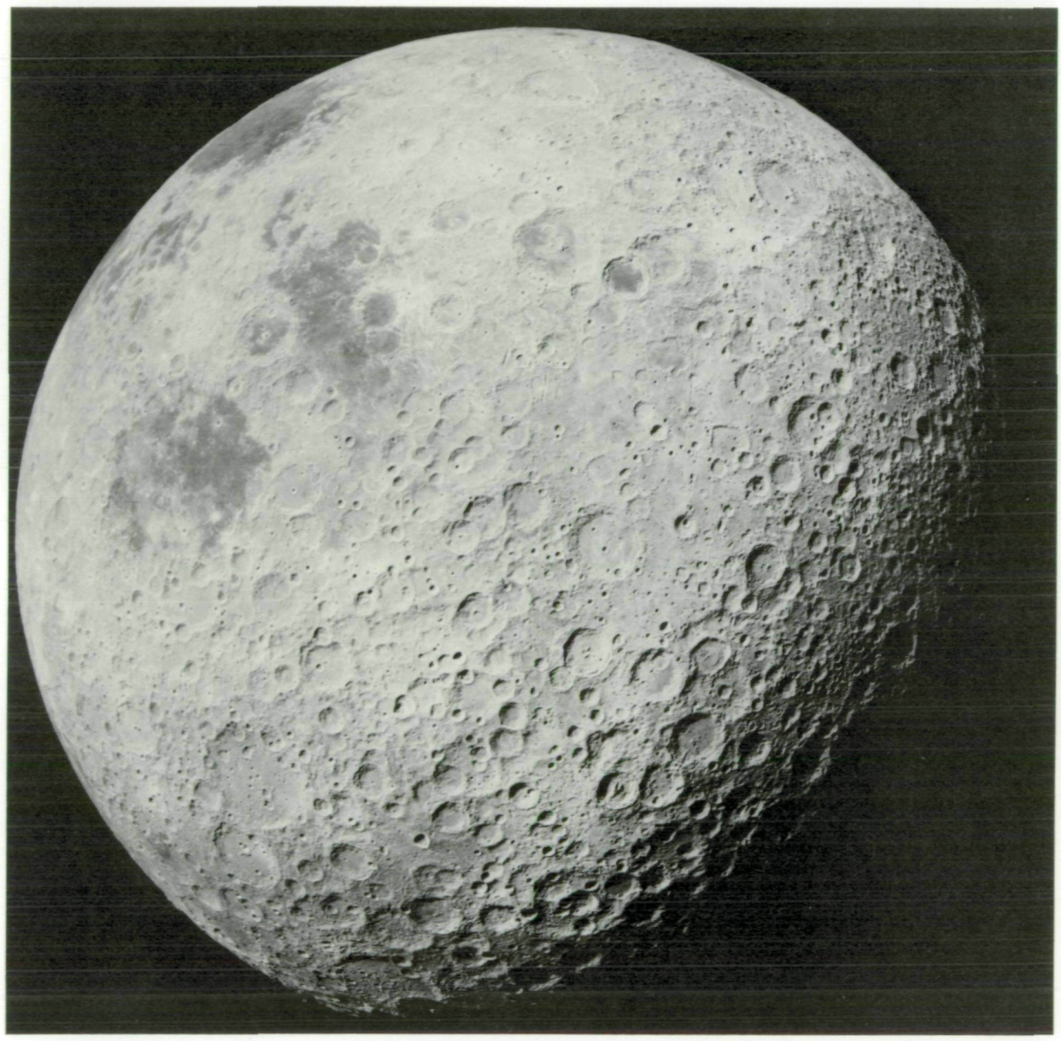
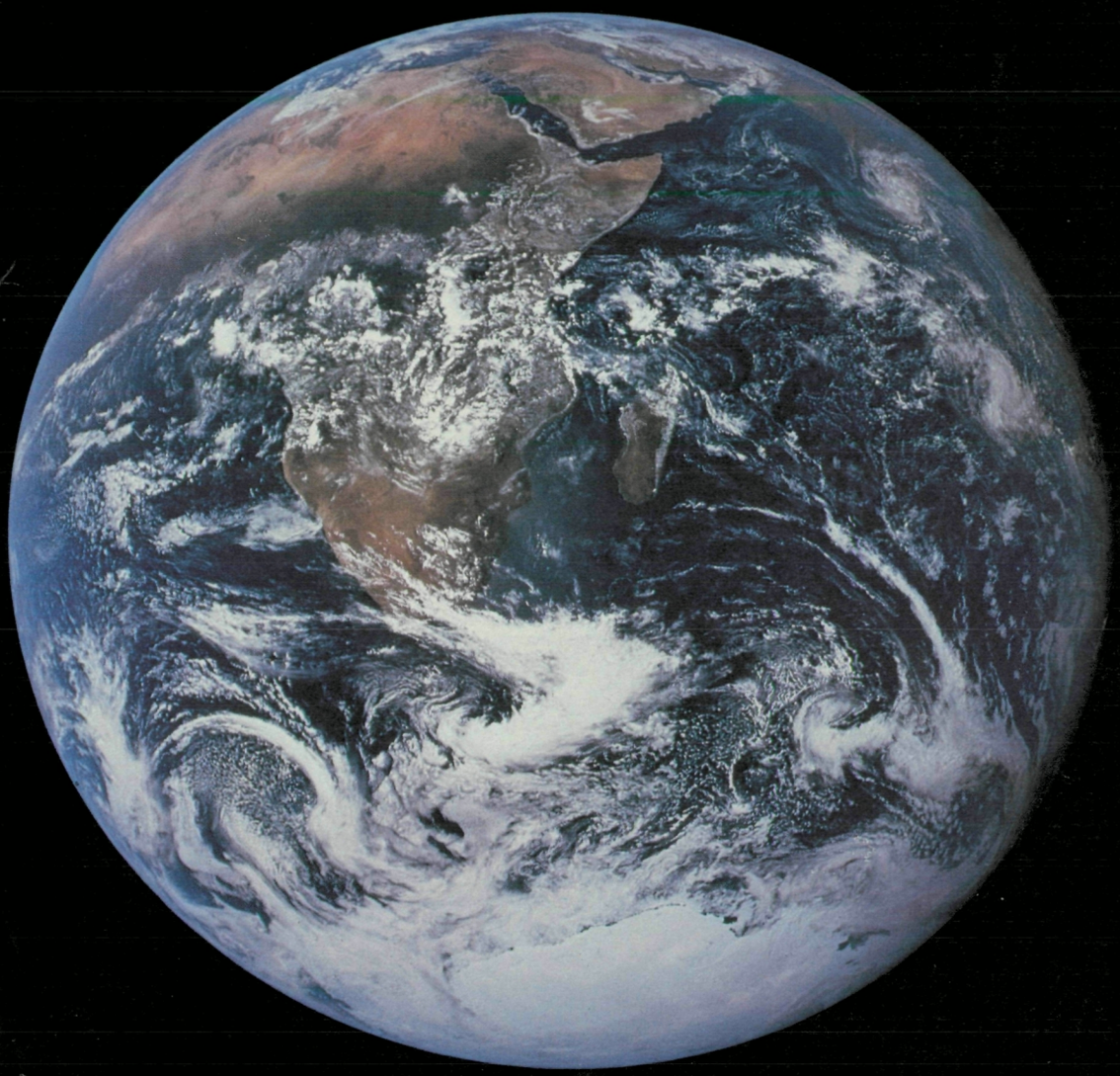
The Blue Planet Astronaut Harrison H. Schmitt took this full-Earth photograph during the Apollo 17 mission from an altitude of 25,000 miles. Africa, Southwest Asia and Antarctica are clearly discernable. Schmitt was accompanied by Astronauts Ronald E. Evans and Eugene A. Cernan on this sixth and last manned lunar landing mission.



The Far Side of the Moon An automatic metric camera mounted on the Apollo 16 command module got this view of almost the entire side of the Moon not visible from the Earth. Among the details clearly shown are the circular Mare Crisium (Sea of Crises) which is on the horizon in the upper left, Mare Marginis (Border Sea) just below it, and Mare Smythii (Smyth's Sea), which is to the left of Mare Marginis. Between Mare Marginis and Mare Smythii is the large crater Neper, and just northeast of Mare Marginis is the crater Lomonosov. Apollo 16 was America's fifth manned lunar landing with Astronauts John W. Young, Charles M. Duke, Jr. and Thomas K. Mattingly II serving as the crew.



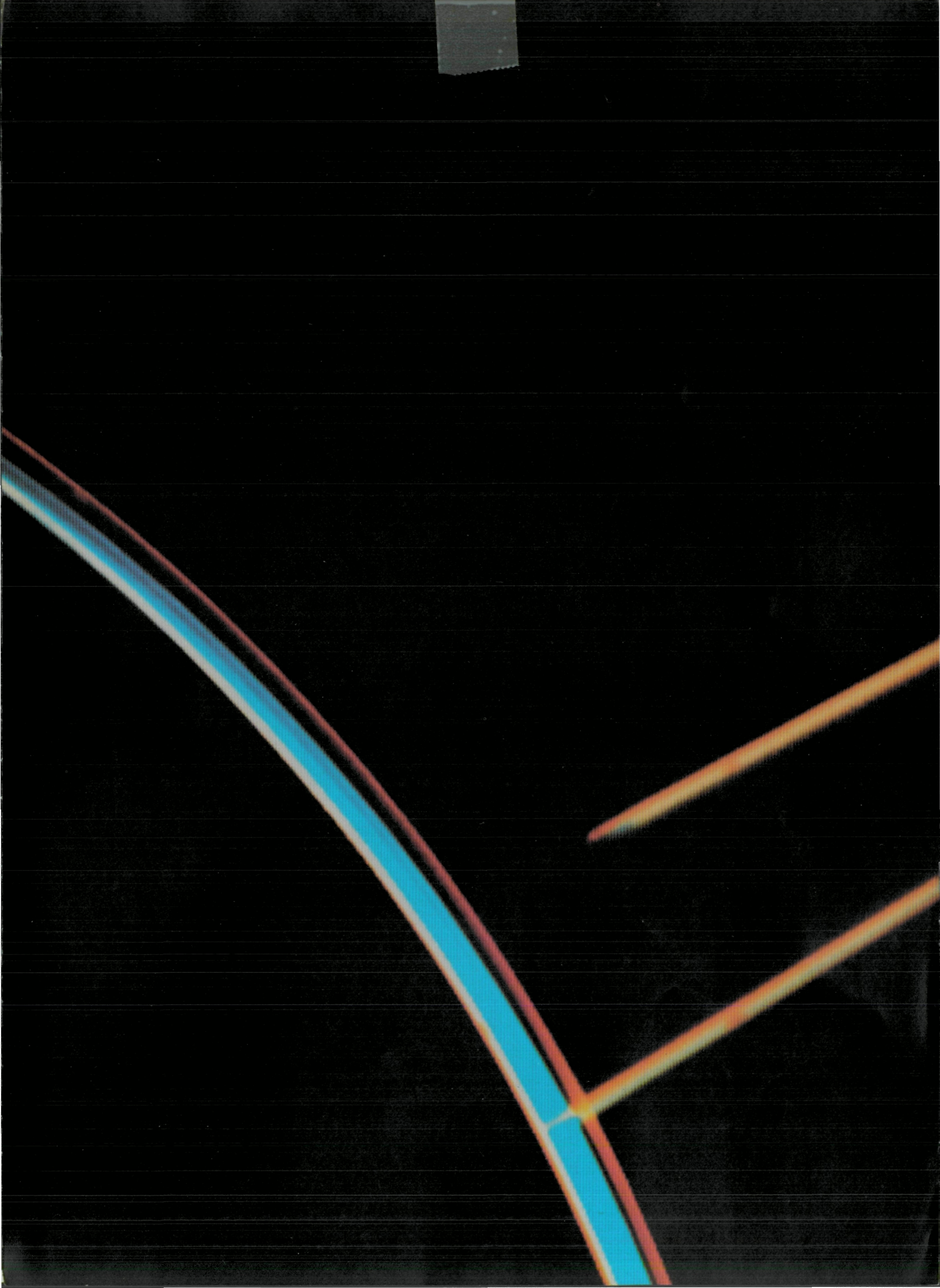
SPACE SCIENCES

With the deployment of Explorer I, the nation's first satellite on February 1, 1958, an area of energetic particles around the Earth's atmosphere, known as the Van Allen Belt, was discovered. Today, NASA, is studying the outer planets through unmanned space probes with names like Viking and Voyager. Two Viking spacecraft soft-landed on Mars in 1976 to search for evidence of life on the red planet. Both Voyager probes have rendezvoused with Jupiter and Saturn, and changed man's concepts—some hundreds of years old—about the nature of the great planet with the red spot, and the planet with the mysterious, yet elegant, system of rings. They have also transmitted new information concerning the numerous moons of these huge planets. Space probes in the Mariner and Pioneer series have encountered Venus and Mercury.

But NASA hasn't confined its space science programs just to the planets. Unmanned vehicles have been launched to study the Sun and its great flares, and to evaluate solar winds which give scientists a better understanding of the effect of these occurrences on the Earth. There are continuing studies of the Earth's atmosphere. And NASA is studying comets, those occasional visitors from other parts of our solar system or the universe which have long fascinated and intrigued mankind.

As NASA's space science efforts enhance our knowledge of the heavens, they will continue to change the way we see ourselves in relation to the universe.

Jupiter's Rings A faint ring system was discovered girdling Jupiter by the Voyager 2 spacecraft during its encounter with the giant planet in July 1979. This picture, taken with an automatic camera on the spacecraft, used orange and violet filters, and was made approximately 1,440,000 kilometers (900,000 miles) from Jupiter.



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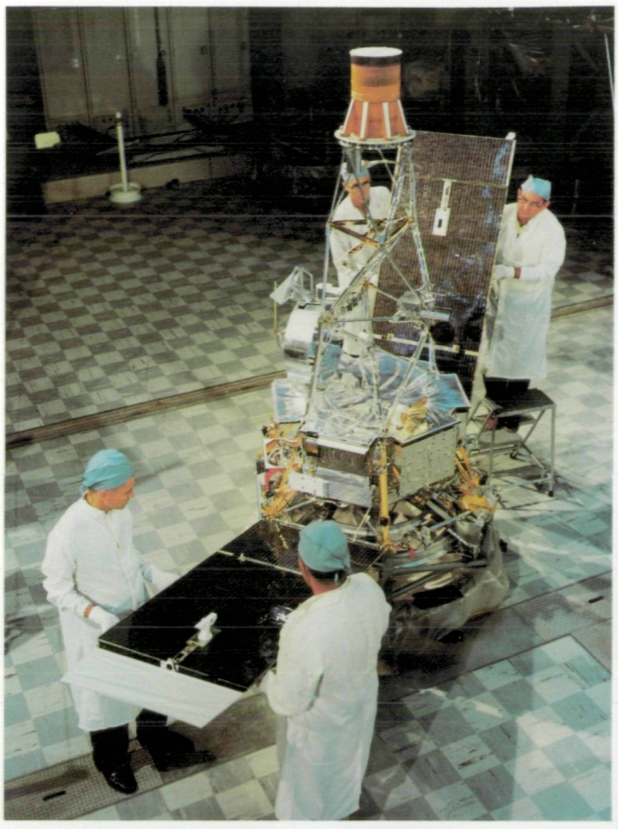
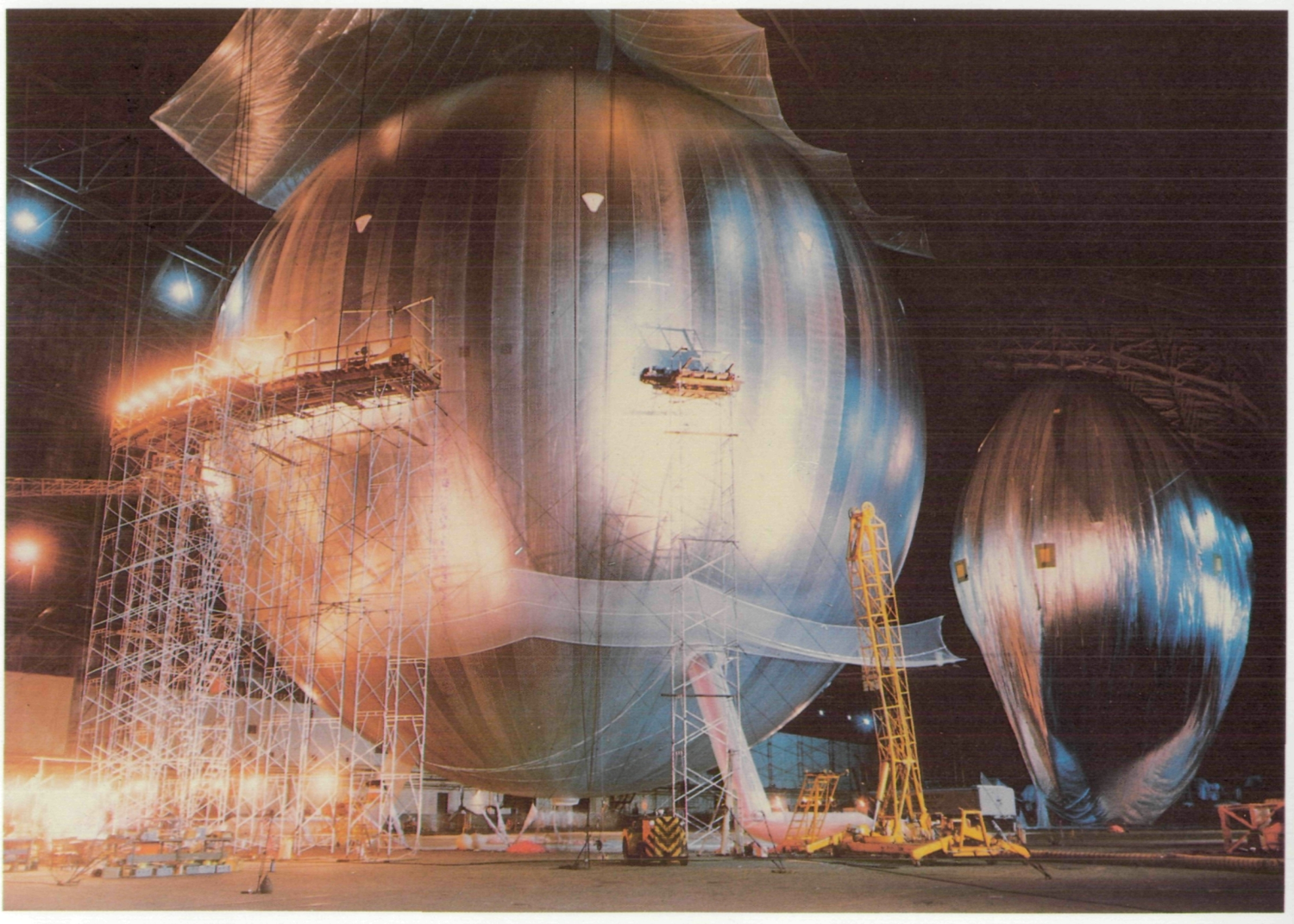


Inflating Echo NASA technicians conduct inflation tests on the Echo 2 passive communications satellite which went into Earth orbit from the Western Space and Missile Center at Vandenberg Air Force Base, California, on January 25, 1964, via a Thor-Agena B rocket. The satellite, which was inflated with helium, after deployment in Earth orbit, was constructed of a mylar polyester sphere 135 feet in diameter which was covered with vapor-deposited aluminum. Echo 2 orbited the Earth as high as 816 statute miles and could be seen from the ground with the naked eye. Echo 2 remained in Earth orbit until June 7, 1969.

Assembling Mariner 2 This was NASA's first successful planetary probe. Mariner 2 traveled 48 million miles to Venus, passed within 22,000 miles of the planet, and its instruments measured Venus' atmosphere, surface temperature and other phenomena.



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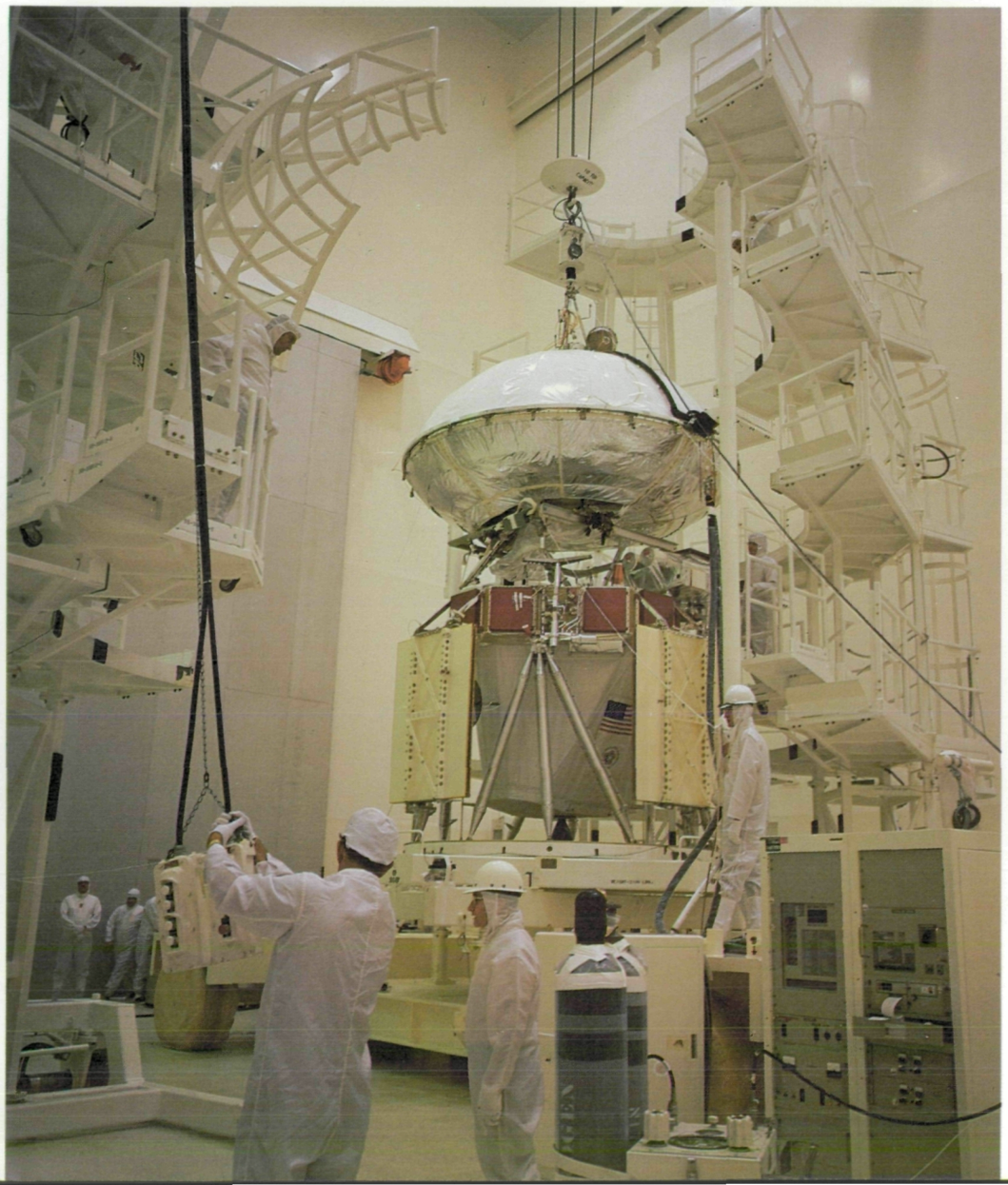
LAGEOS Satellite Test Scientists at the Goddard Space Flight Center in Greenbelt, Maryland, conduct pre-launch evaluations of the Laser Geodynamic Satellite (LAGEOS). This Satellite was launched by a Delta rocket from the Western Space and Missile Center at Vandenberg Air Force Base, California, on May 4, 1976. It was the first satellite in the solid-Earth dynamics portion of NASA's Earth and Ocean Dynamics Program. The 410-kg (903-pound) space vehicle was used to provide a reference point for laser ranging experiments, such as those applied to the monitoring of the Earth's tectonic plate motion. Scientists use data from tectonic plate motion studies as an aid in identifying potential earthquake areas.



Preparing Viking I for Mars In the sterile environment of NASA's launch facility at the Kennedy Space Center at Cape Canaveral, technicians mate the Viking I orbiter and nuclear powered lander in preparation for the unmanned spacecraft's August 20, 1975 launch from the Cape by a Titan III/Centaur rocket. Viking I, which successfully soft-landed on Mars on July 20, 1976, was the first American space vehicle to land on another planet. The lander's instrumentation conducted an investigation on the surface of Mars for the presence of life on the planet. On September 9, 1975, a second Mars probe, Viking 2, was launched and soft-landed on Mars on September 3, 1976.

To Study the Sun In this night scene at the Kennedy Space Center at Cape Canaveral, a Delta rocket is readied for the February 14, 1980, launch of NASA's Solar Maximum Mission spacecraft. The satellite which was placed in Earth orbit, was the first spacecraft specifically designed for the study of solar flares, the violent eruptions on the Sun's surface. The objective of the mission was to help scientists gain a better understanding of the Sun and its effects on the Earth.

Infrared Astronomical Satellite (IRAS) Pre-Launch Preparations IRAS is designed to detect "cold" objects in deep space that do not shine in visible light, but emit radiation in the infrared wavelengths. Its sensitive instruments have already detected what may prove to be a solar system orbiting another star.

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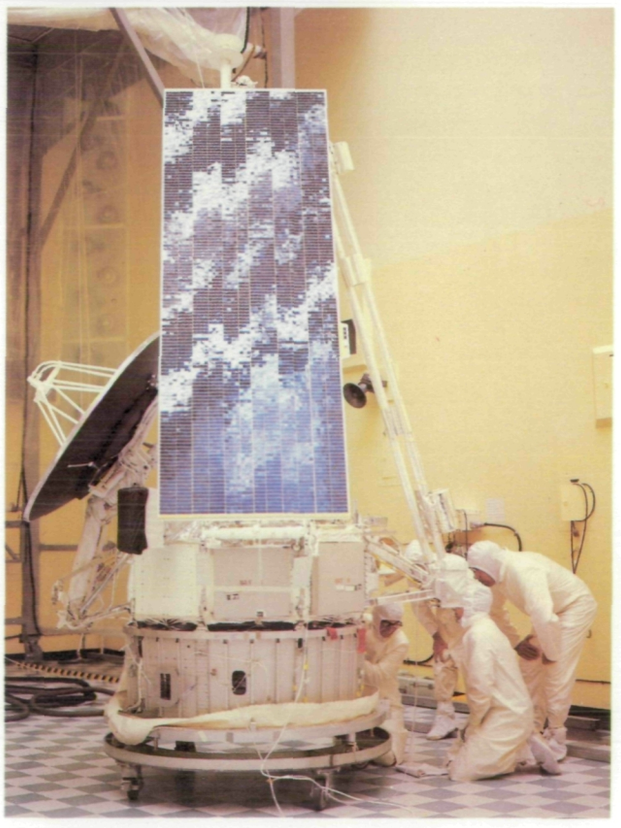

Preparing Mariner 10 for Launch NASA technicians perform build-up work on the Mariner 10 spacecraft in a hanger at the Kennedy Space Center at Cape Canaveral. The spacecraft's blue solar panels are shown in their launch configuration. Mariner 10 was NASA's first dual planet mission. The unmanned space vehicle flew by Venus and Mercury in February and March 1974, respectively, and made a second Mercury fly-by in September of that year. Mariner 10, which transmitted the first photos to Earth of the two planets nearest the Sun, was launched from the Cape on November 3, 1973 by an Atlas-Centaur rocket.

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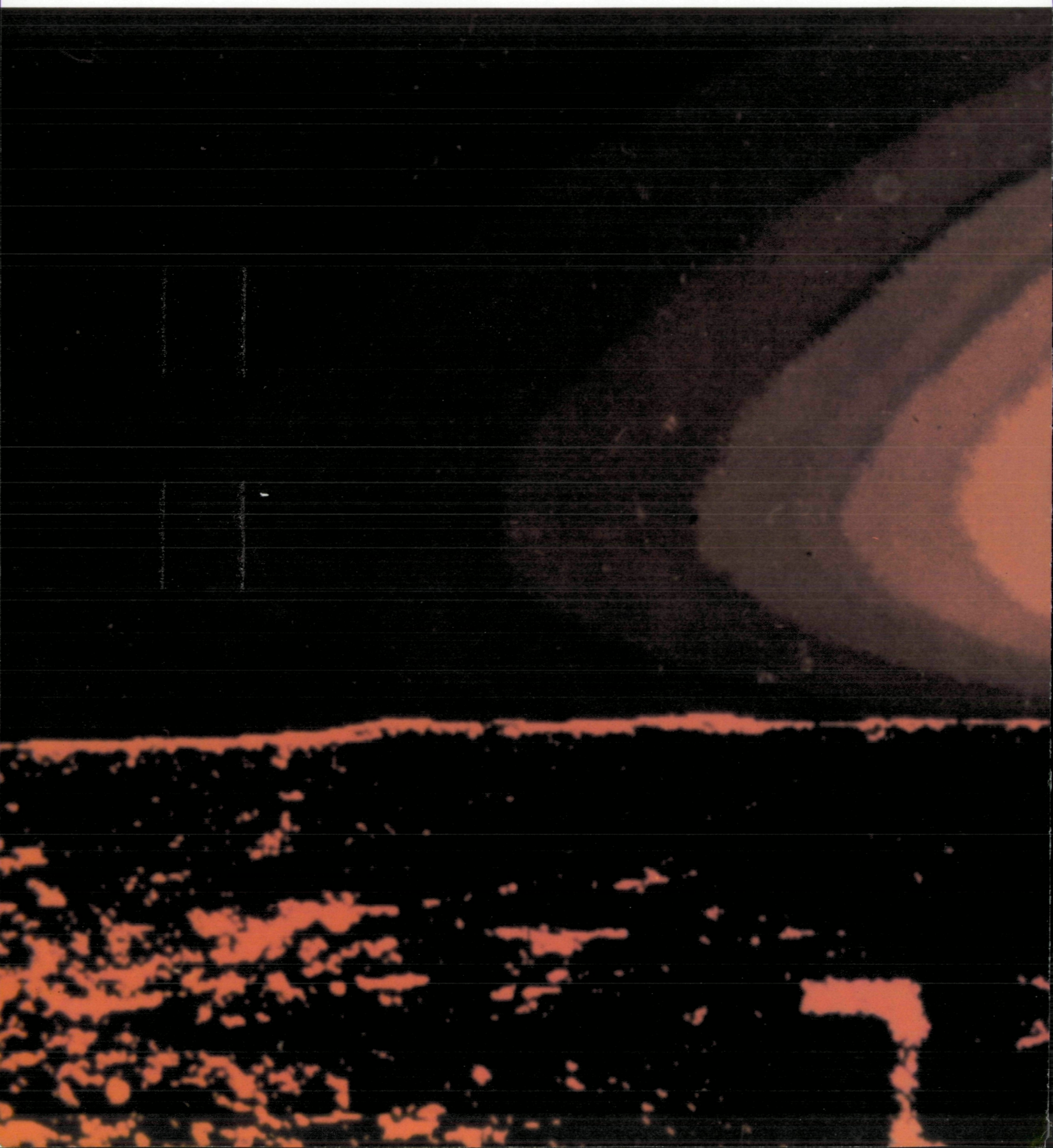

Martian Sunset On August 20, 1976, exactly one year after it was lifted off from the Kennedy Space Center at Cape Canaveral by its Titan III/ Centaur launch vehicle, Viking I transmitted this striking photo from the surface of Mars using its automatic television camera. The Martian sunset scene was computer-enhanced. In the lower right, the top of one of the Viking's power system covers can be seen. Near the Sun, the sky appears white due to light saturation of the camera. The blue to red color variation is explained by a combination of scattering and absorption of sunlight by atmospheric particles.

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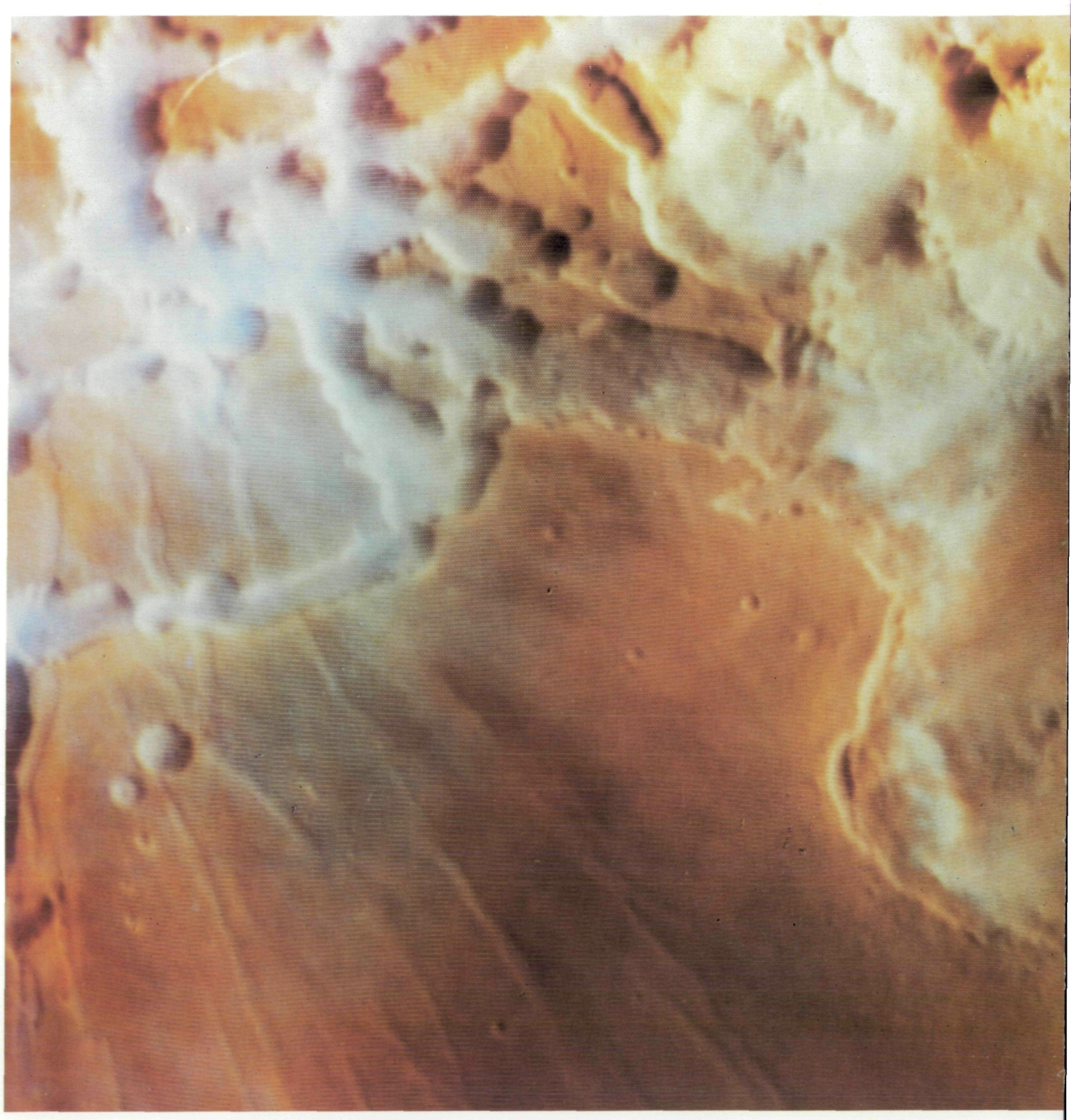

Foggy Morning in a Martian Valley White patches of early-morning fog and mist fill a rugged network of Martian canyons and spill out onto the surrounding high, rust-colored plateau. The clouds are probably formed by water vapor that has frozen out of the air during the previous Martian night. In the sunlight, the water vaporizes again, becoming briefly visible as mist before being absorbed into the dry atmosphere. This part of Mars, called Labyrinthus Noctis (The Labyrinth of the Night) was photographed at dawn by the Viking 1 Orbiter; the view covers an area about 100 kilometers (62 miles) on a side. The color picture was made by superimposing three separate black-and-white images taken through color filters.

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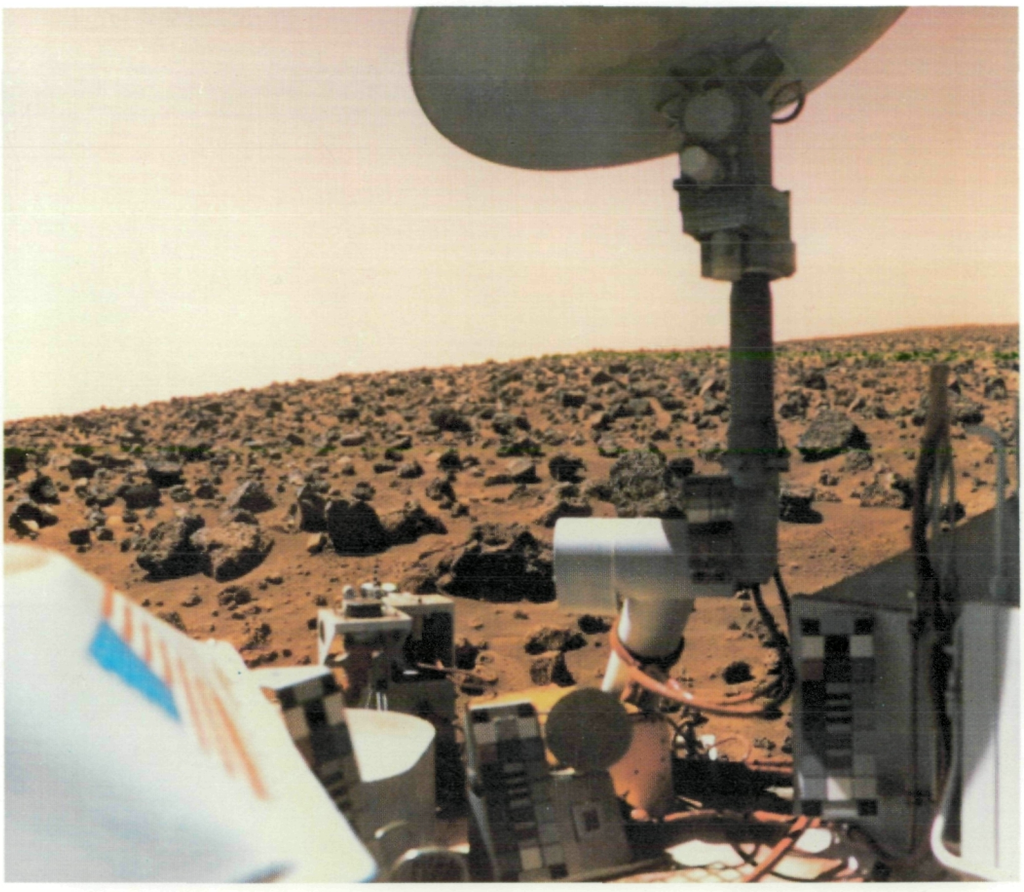
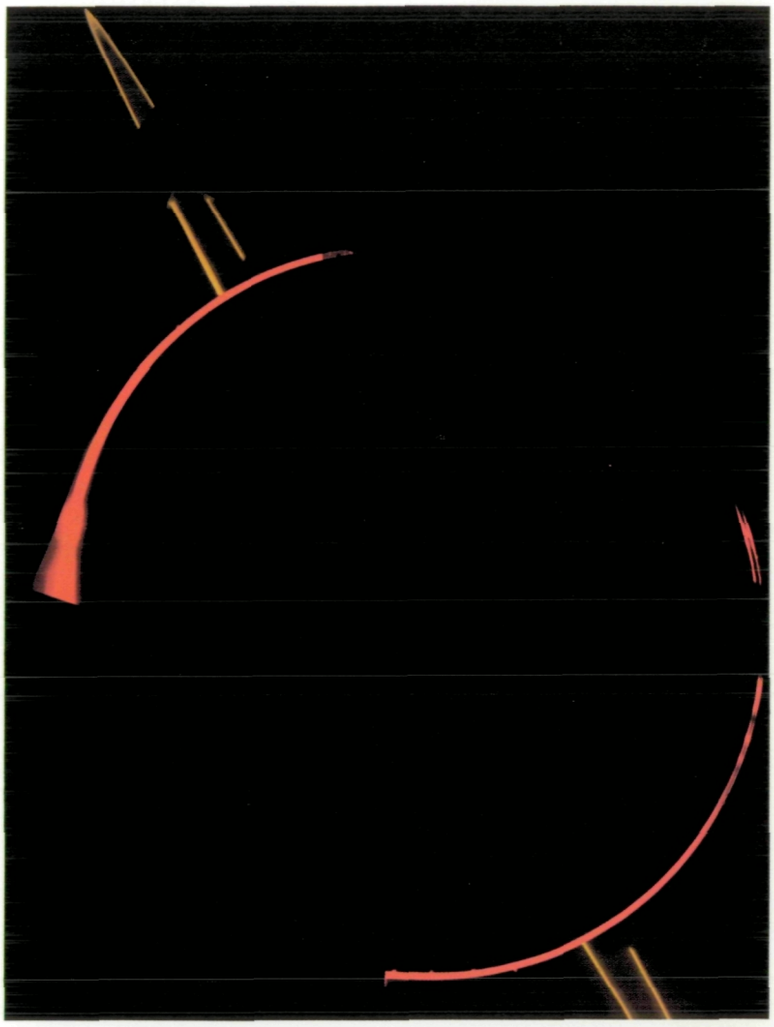


"Mars, this is Viking... Viking, this is Mars" An apparent welcoming committee of lava-like Martian rocks is framed by the radio antenna (top) and other instruments on the Viking 2 Lander. The pink color of the sky is produced by fine red dust carried by the Martian winds. The American flag (left) and several color calibration charts helped scientists determine the actual color of the Martian sky and landscape from the pictures returned by Viking's cameras.

A Red Sky for a Red Planet The red surface of Mars lends its color to the Martian sky in this view from the Viking 1 Lander, Fine red dust from the soil is carried into the atmosphere, giving the sky a pinkish hue instead of the blue color expected by scientists. Light and dark boulders are strewn on the surface of the foreground, and light-gray ledges of bedrock appear through the soil in the middle distance. The horizon, about 100 meters (330 feet) away, may be the rim of an impact crater. This color picture was made by combining three separate pictures, each taken through a different color filter. The colors were matched by comparing similar pictures taken of colored objects on the Viking Lander itself.



Sparkling Ring of Jupiter Voyager 2 looks back to see the ring of Jupiter sparkling in the Sunlight. The ring appears brighter when looking toward the Sun.

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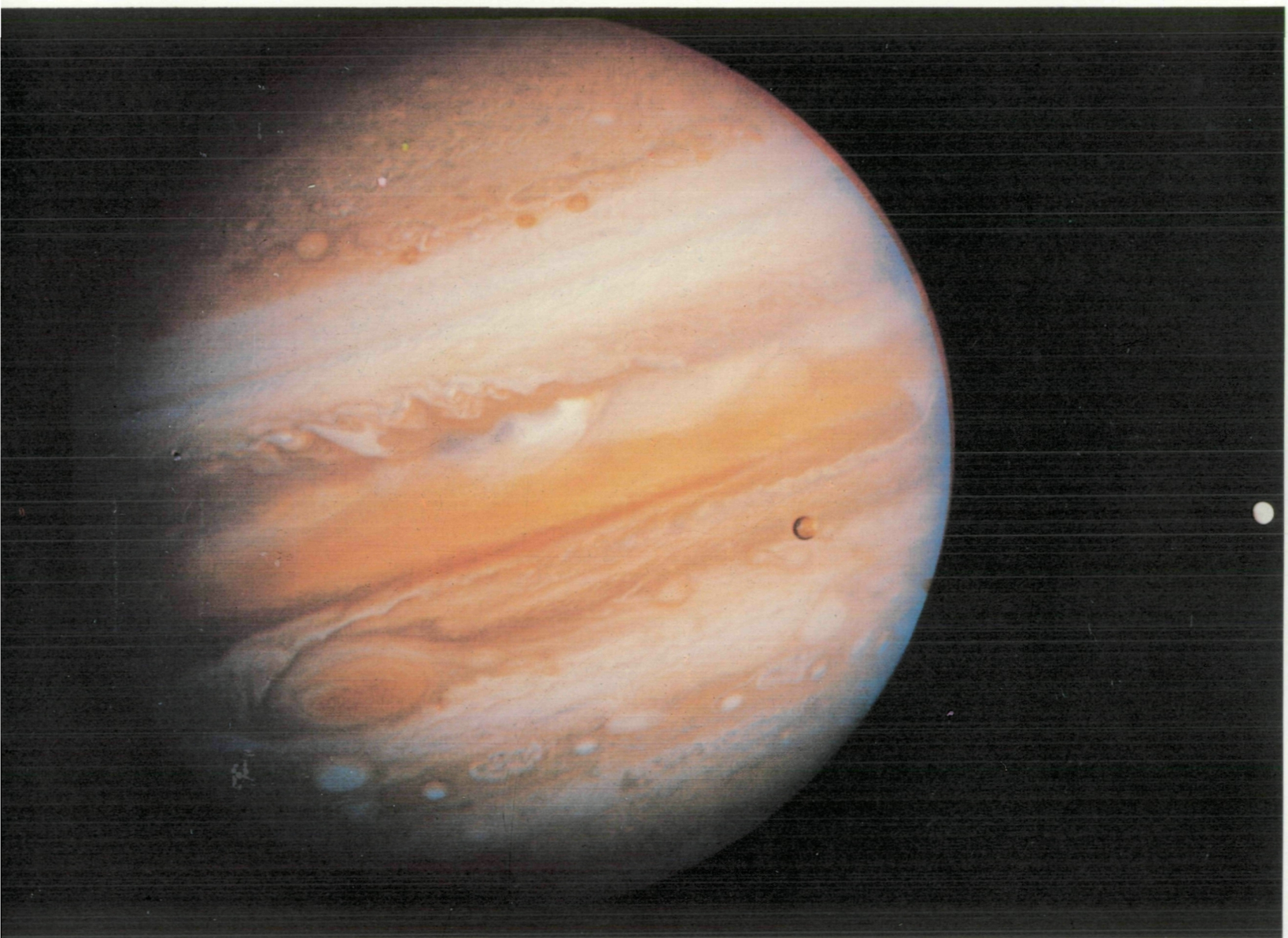
Great Storms of Jupiter An exercise in cosmic modern art, huge whirling storms and sawtoothed, turbulent flows spread out in Jupiter's atmosphere as pictured by Voyager 2 from 6 million kilometers (3.7 million miles). The Red Spot (right center) is a huge storm system, big enough to hold three Earths, that has persisted for at least three centuries. It whirls counterclockwise, producing highly contorted patterns at its left, where cloud banks moving left to right are blocked and forced to squeeze past it. Smaller white oval storms, about the size of Earth, create similar turbulent effects below the Red Spot. Most patterns in Jupiter's atmosphere are constantly changing; the structures shown here have changed significantly since Voyager 1 photographed them four months previously.

Moons of Jupiter Red Io and white Europa orbit above Jupiter's multihued clouds. The Great Red Spot is the largest of many storms. This photo of Jupiter and its moons was transmitted back to Earth over a distance of 28.4 million kilometers (17.5 million miles) by Voyager 1 on February 5, 1979.

Callisto, a Moon of Jupiter Voyager spacecraft recorded this "close-up" of Jupiter's outermost satellite Callisto on March 6, 1979. Callisto is the second largest of Jupiter's moons with a diameter of 4,820 kilometers (2,995 miles).



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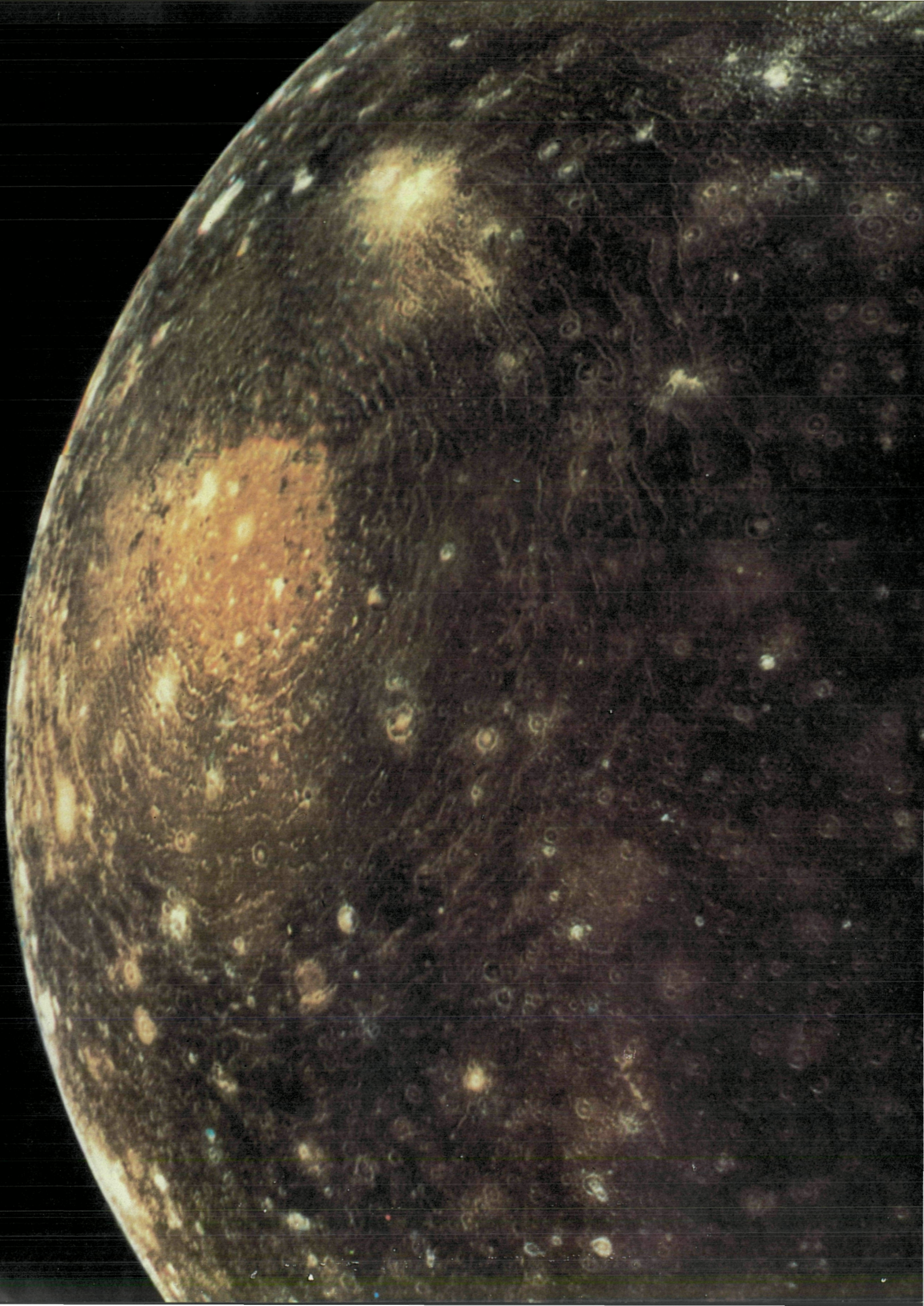

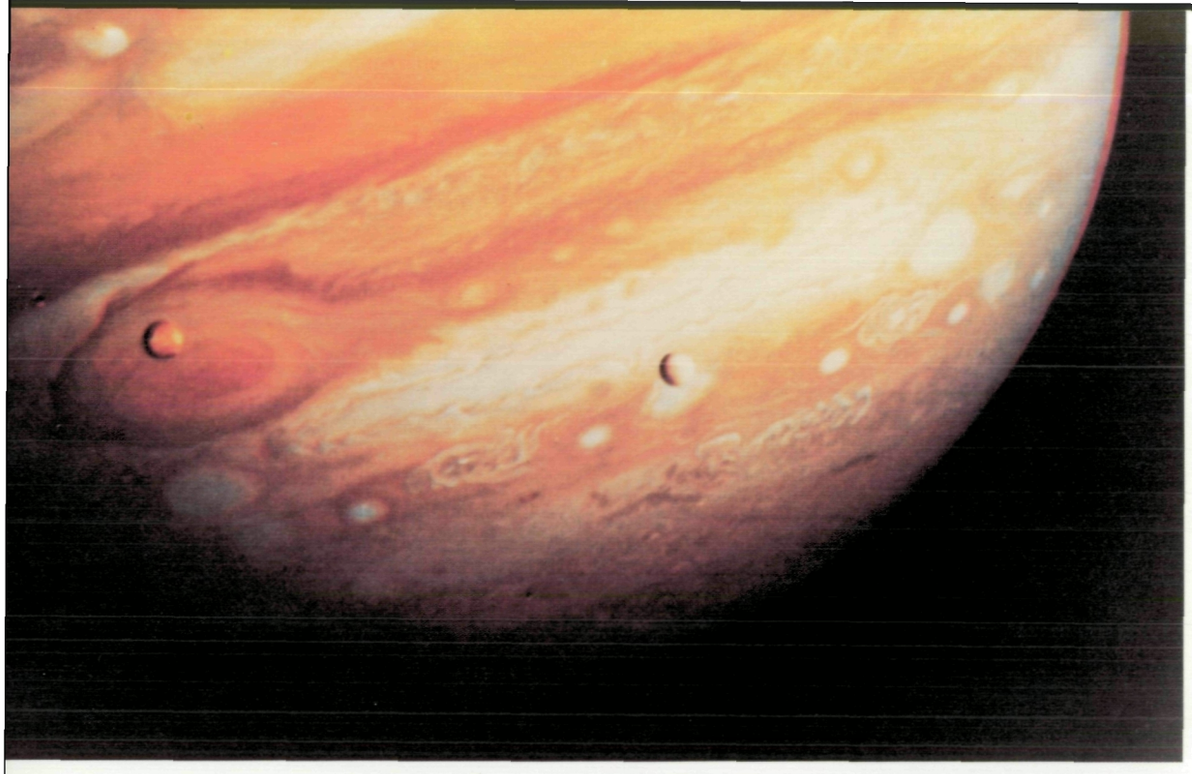

Moons of Jupiter/Close-up Io (left) and Europa (right) pass before the planet's Great Red Spot. The long bright region between two white ovals (across center of picture) extends high into Jupiter's atmosphere.

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Jupiter Unwrapped This cylindrical mosaic projection of the planet Jupiter was made from photographs transmitted by the unmanned Voyager I spacecraft on January 6,1979, as the vehicle circled above the great planet's equator. The various exposures were then pieced together to form this image, which indicates Jupiter's different zones. Using the key shown in the photograph, the zones are the NTEZ (North Temperate Zone), NTRZ (North Tropical Zone), NEB (North Equatorial Belt), EZ (Equatorial Zone), SEB (South Equatorial Belt), STRZ (South Tropical Zone) and STEZ (South Temperate Zone).

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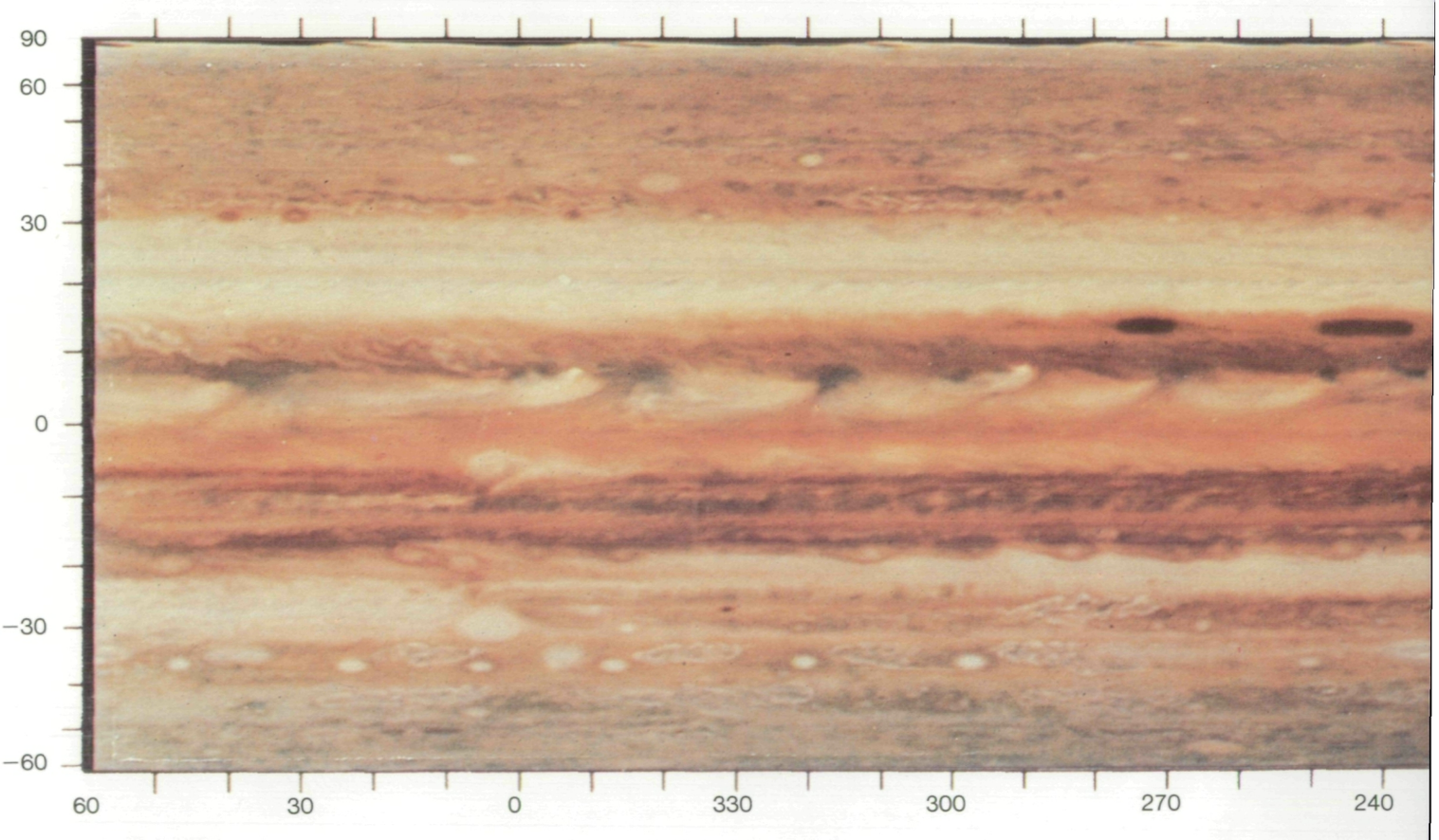

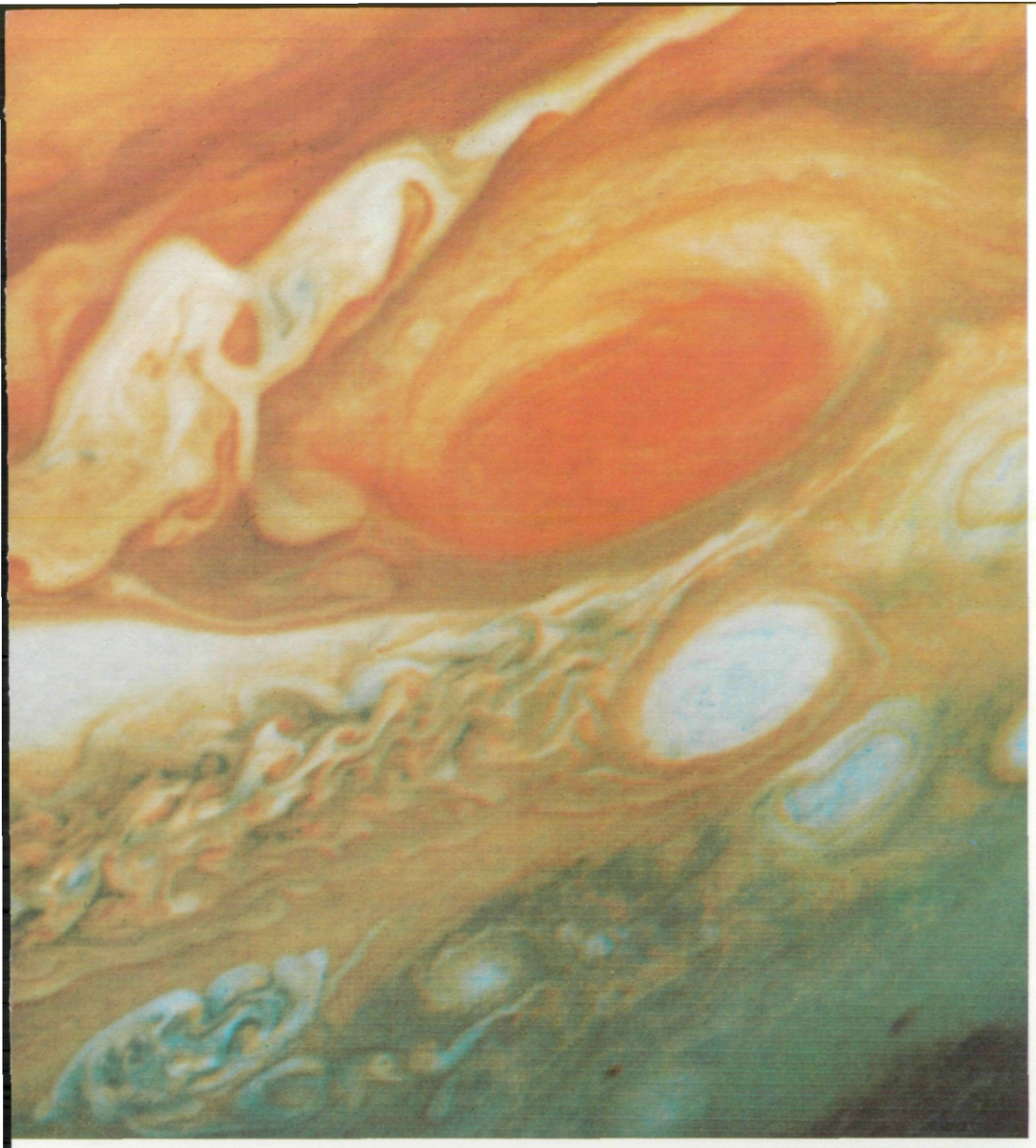

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Upheaval on a Moon This close-up photo of the turbulent surface of Io shows two volcanic calderas and associated lava flows. The constant volcanic turmoil on this moon of Jupiter serves to effectively resurface any impact craters made by colliding space matter. The most geologically active body in the solar system, Io has a diameter of 3,632 kilometers (2,257 miles), which is similar to that of our Moon.

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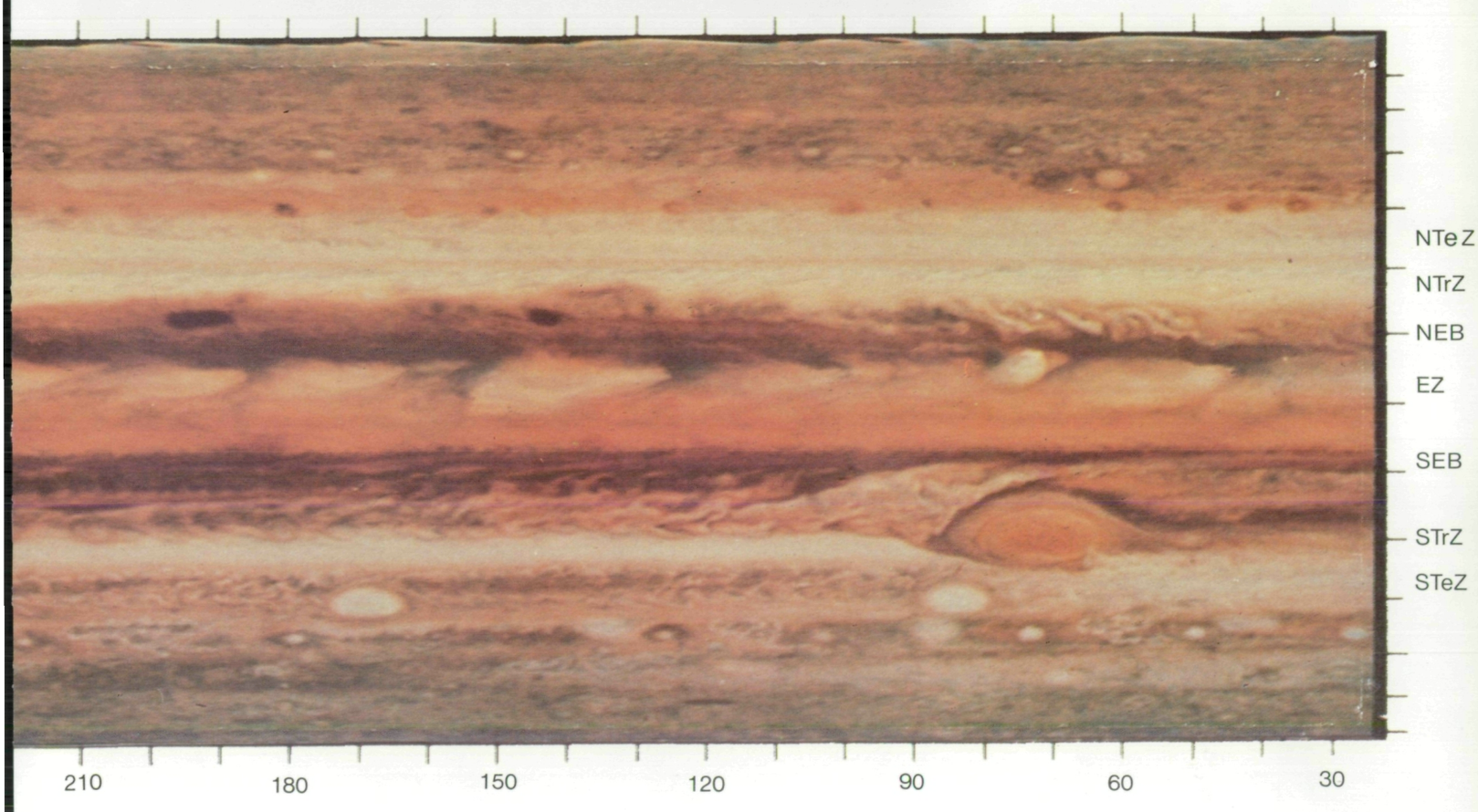
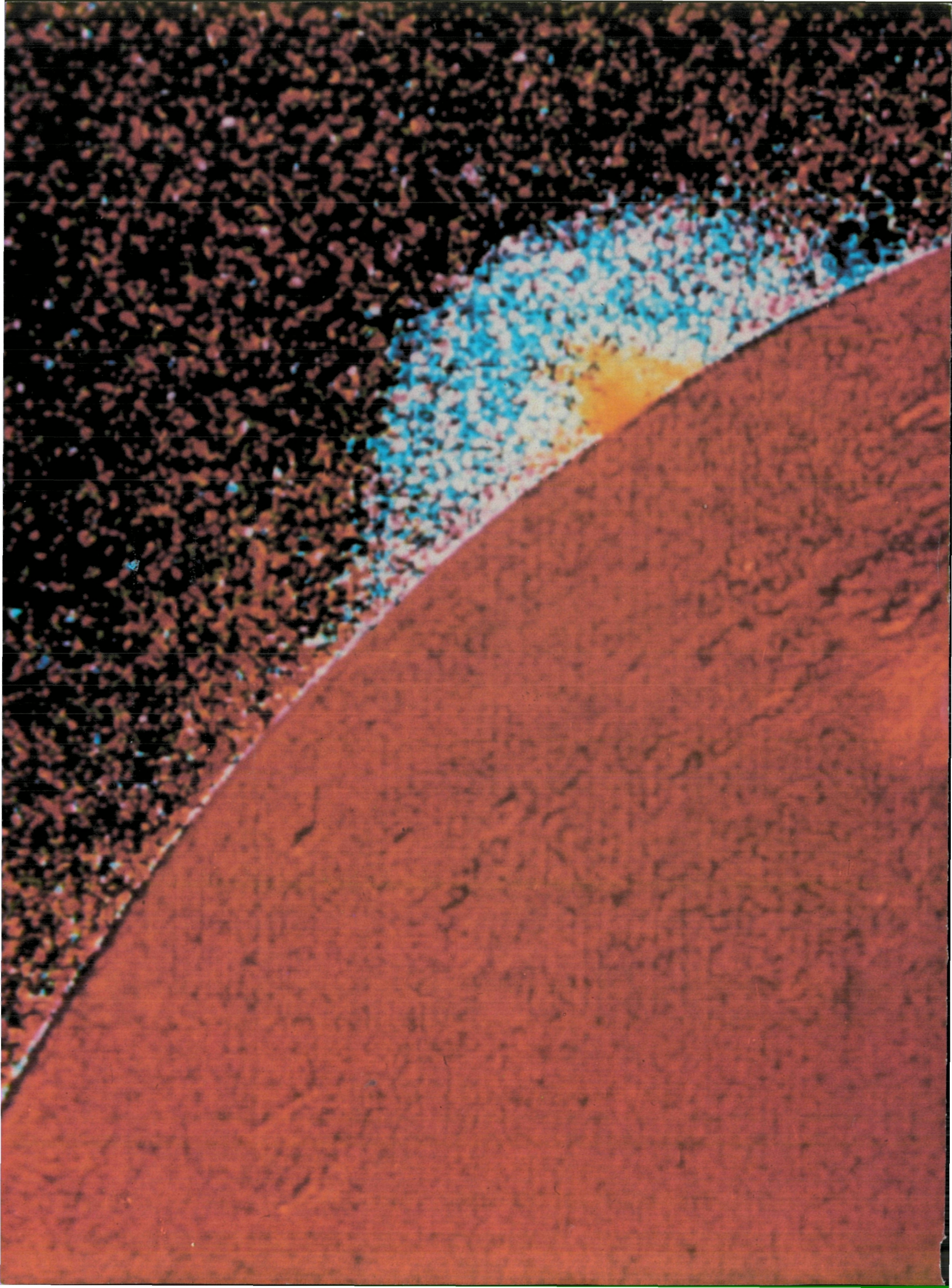
Jupiter's Red Spot A dramatic view of Jupiter's Great Red Spot and the surrounding area shows cloud details as small as 160 kilometers (100 miles). The turbulent cloud pattern to the left of the Great Red Spot is a region of extraordinarily complex and variable winds.





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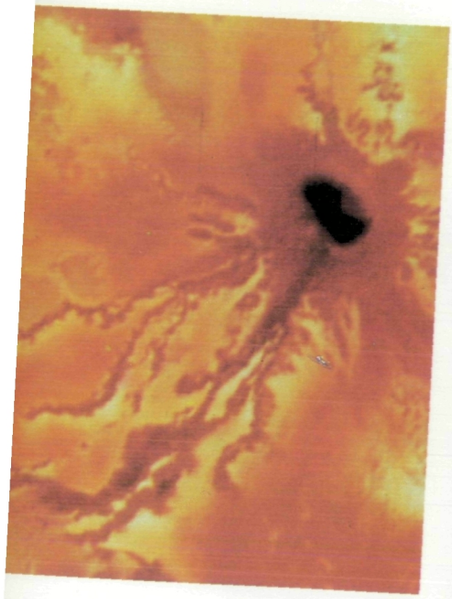

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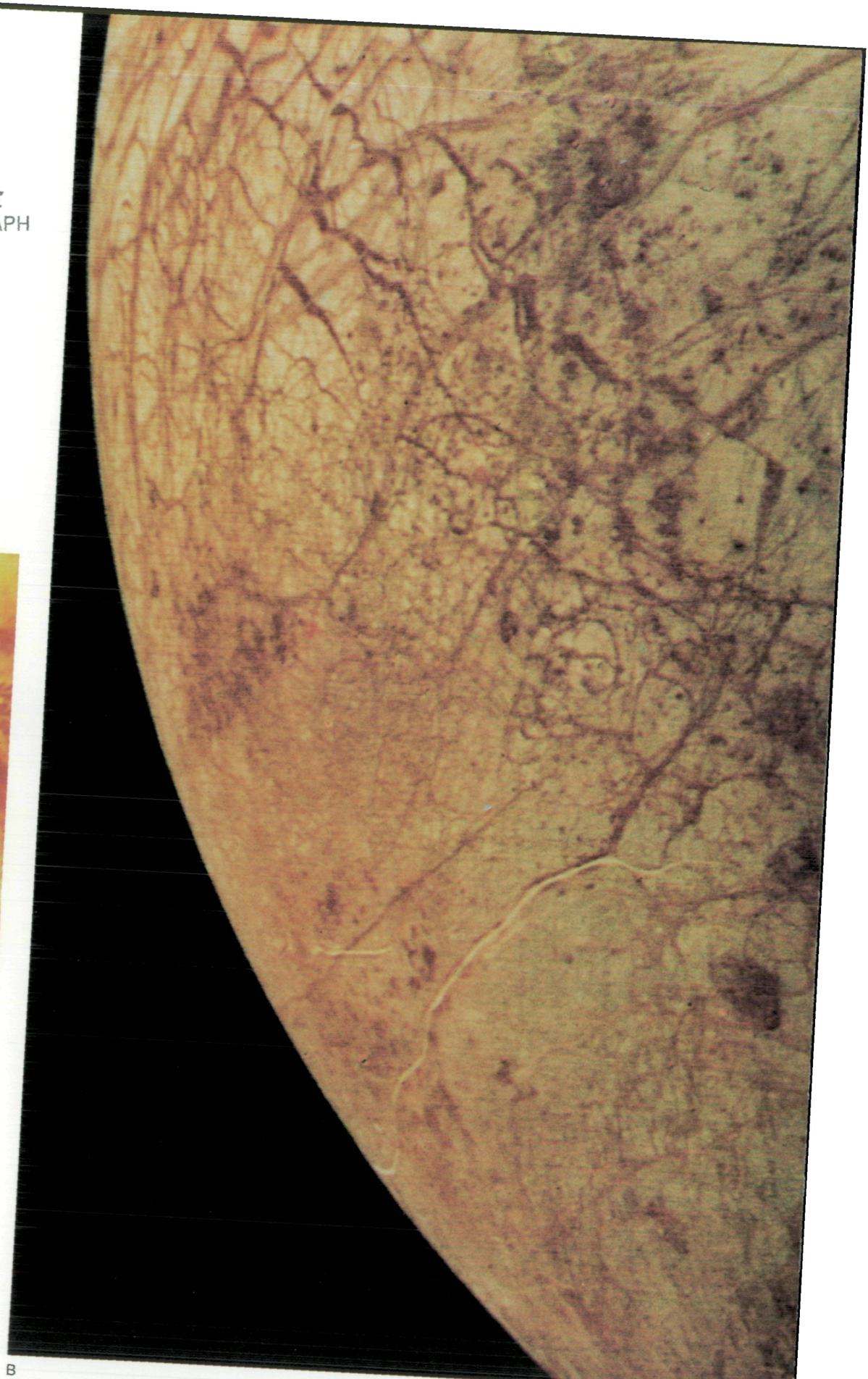

B

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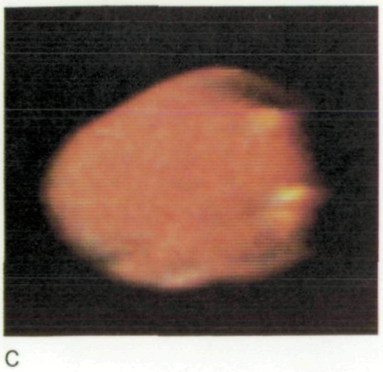
The Surfaces of Jupiter's Moons
A. This close-up photo of Io from Voyager I shows Io's south polar region. B. Europa appears remarkably smooth and shows few craters. C. Amalthea is darker than the other moons of Jupiter and is very small. It is about 270 by 165 by 150 kilometers (168 by 103 by 93 miles). D. Another close-up of Io shows two volcanic calderas and associated lava flows. E. The surface of Ganymede shows a dark, crater-filled moonscape.



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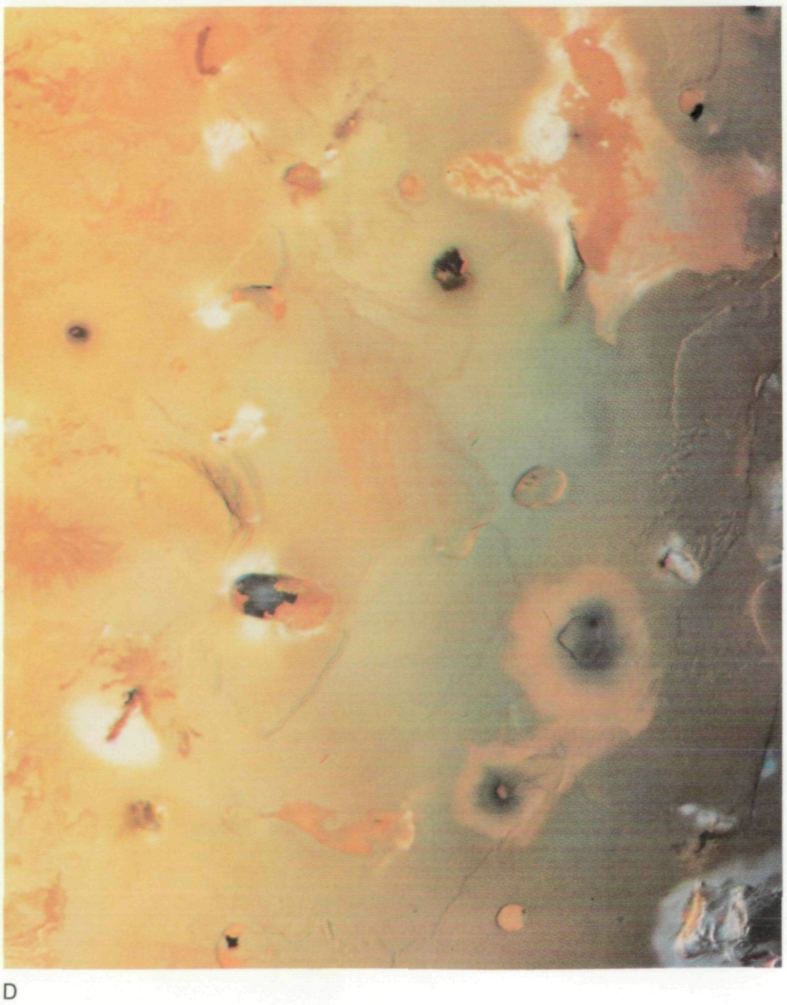

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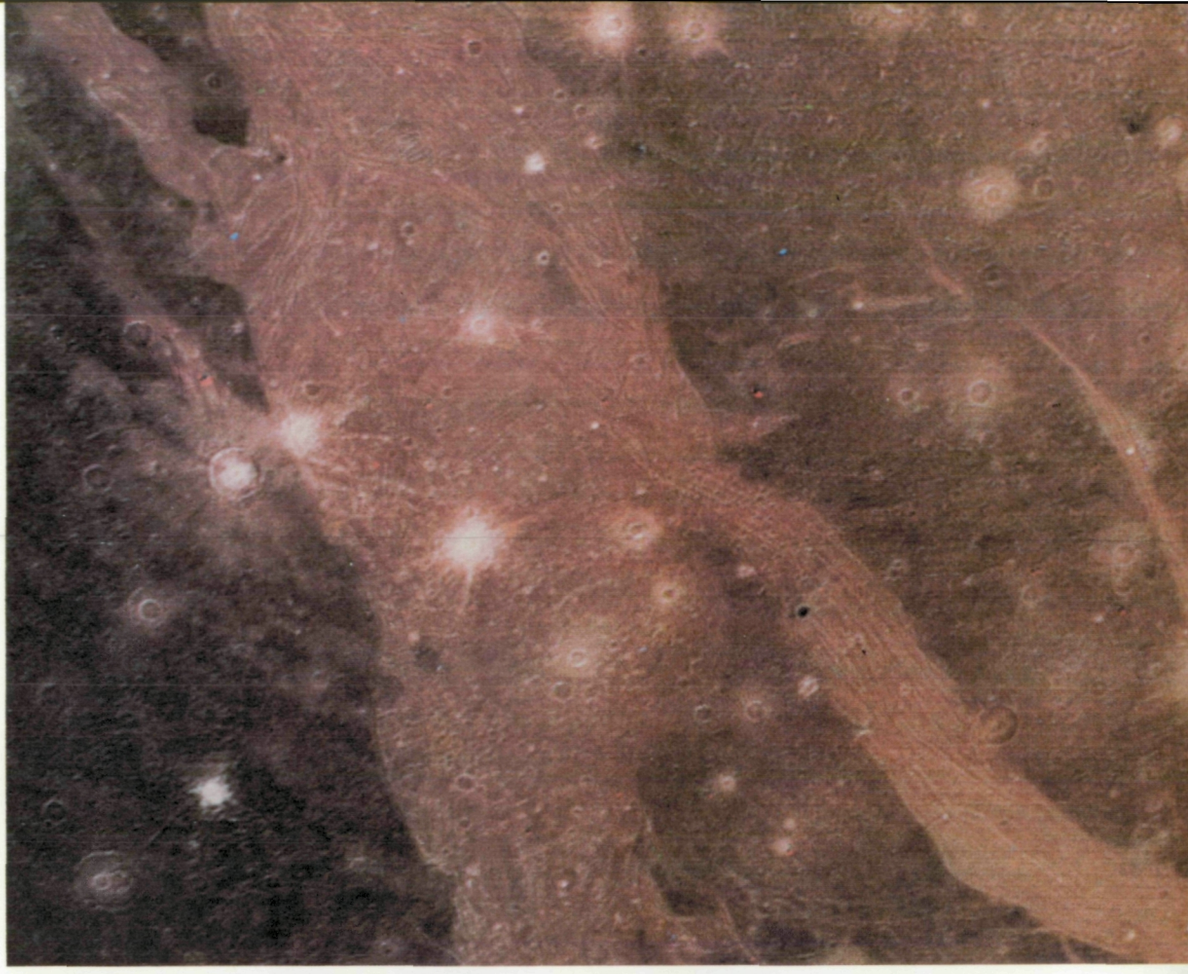

E

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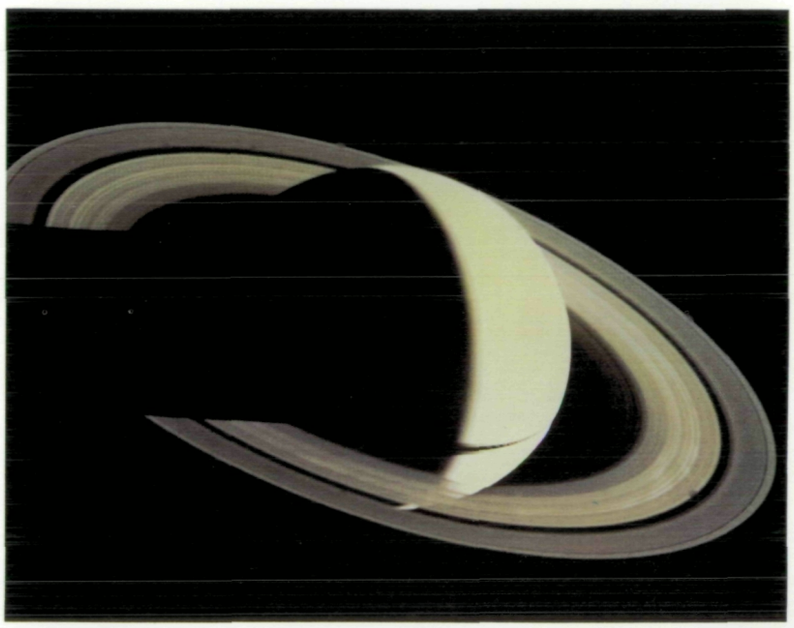
Northern Side of Saturn
Voyager recorded this "poster-like" image of Saturn as it flew away from the planet. The spokes appear lighter here, than they did during Voyager's approach to the planet.



Separate Rings of Saturn
Sunlight can be seen streaming through the Cassini Division and another gap at the inner edge of the B-ring in this Voyager photo. The shadow cast by the C-ring is not as dark. Two icy satellites, Tethys and Dione orbit the planet in this photo.

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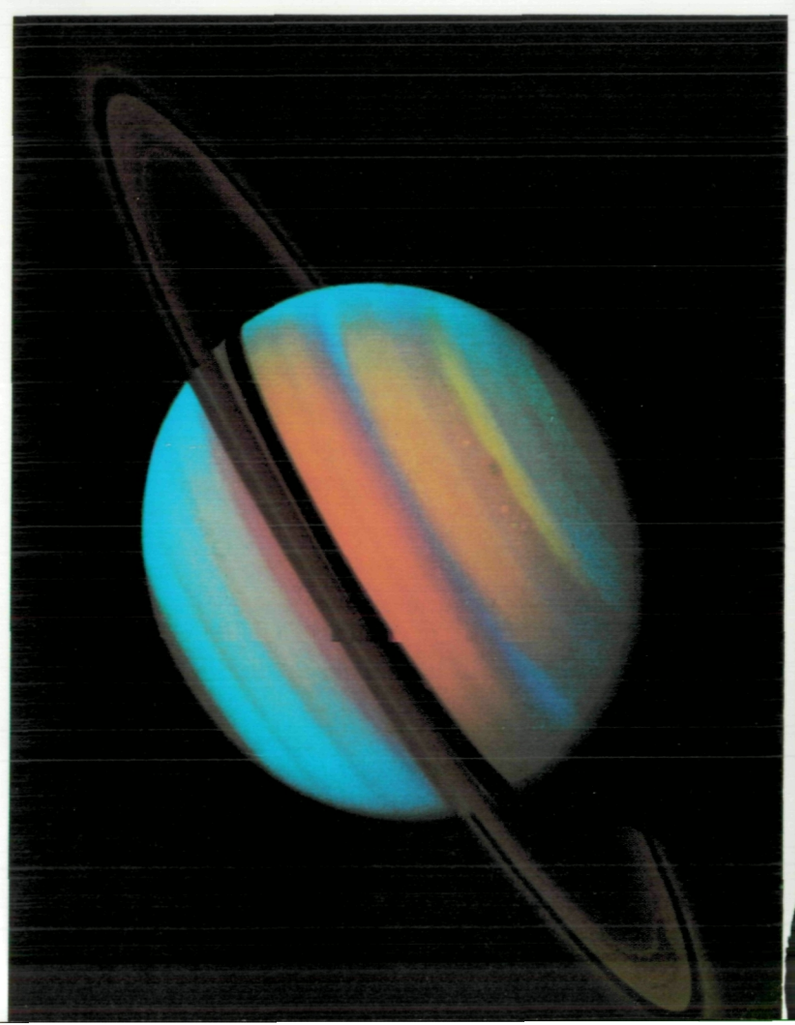
False Color Image of Saturn
Saturn appears to glow in this false-color rendition of a photo taken through ultraviolet, green and violet filters.



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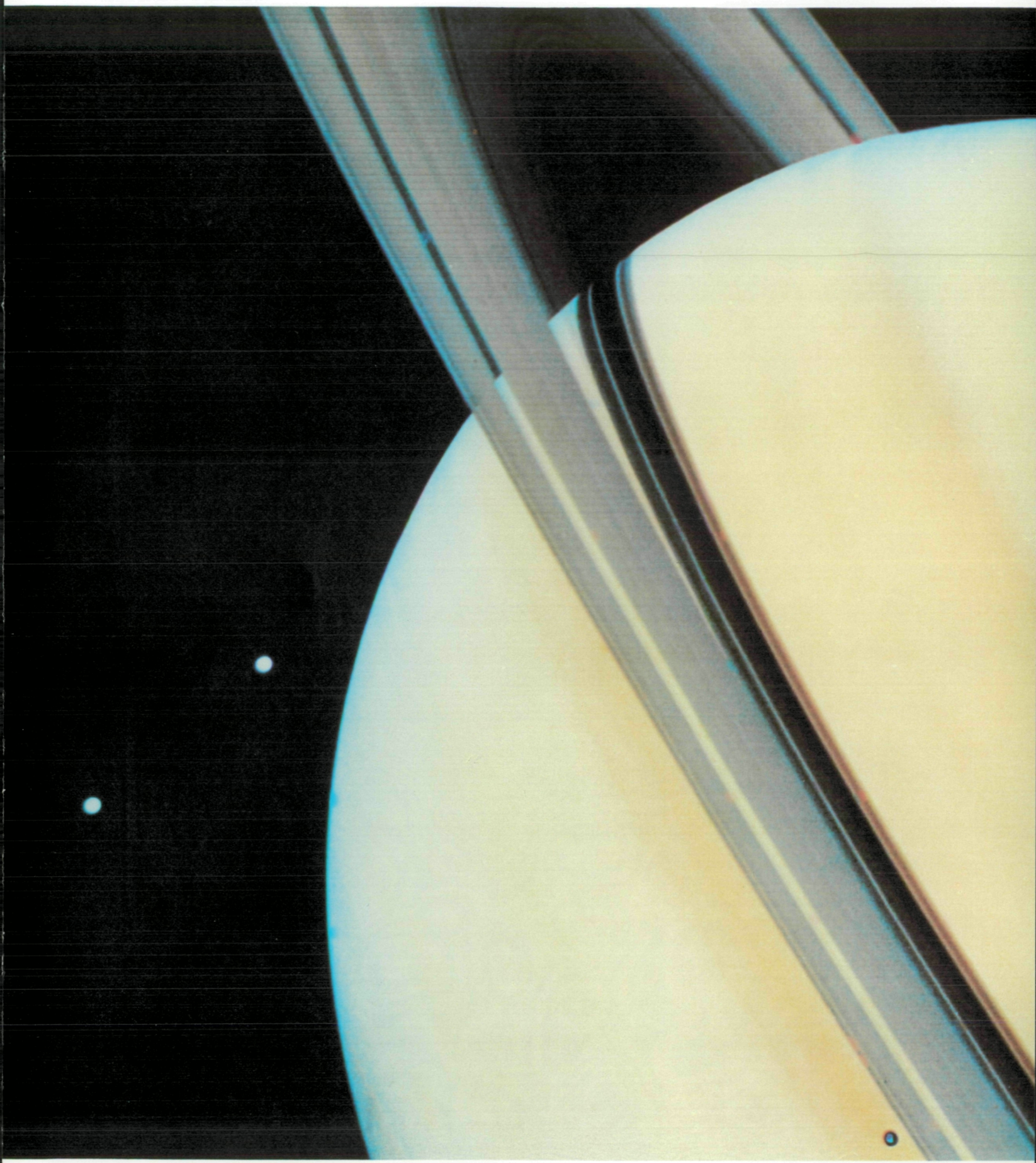

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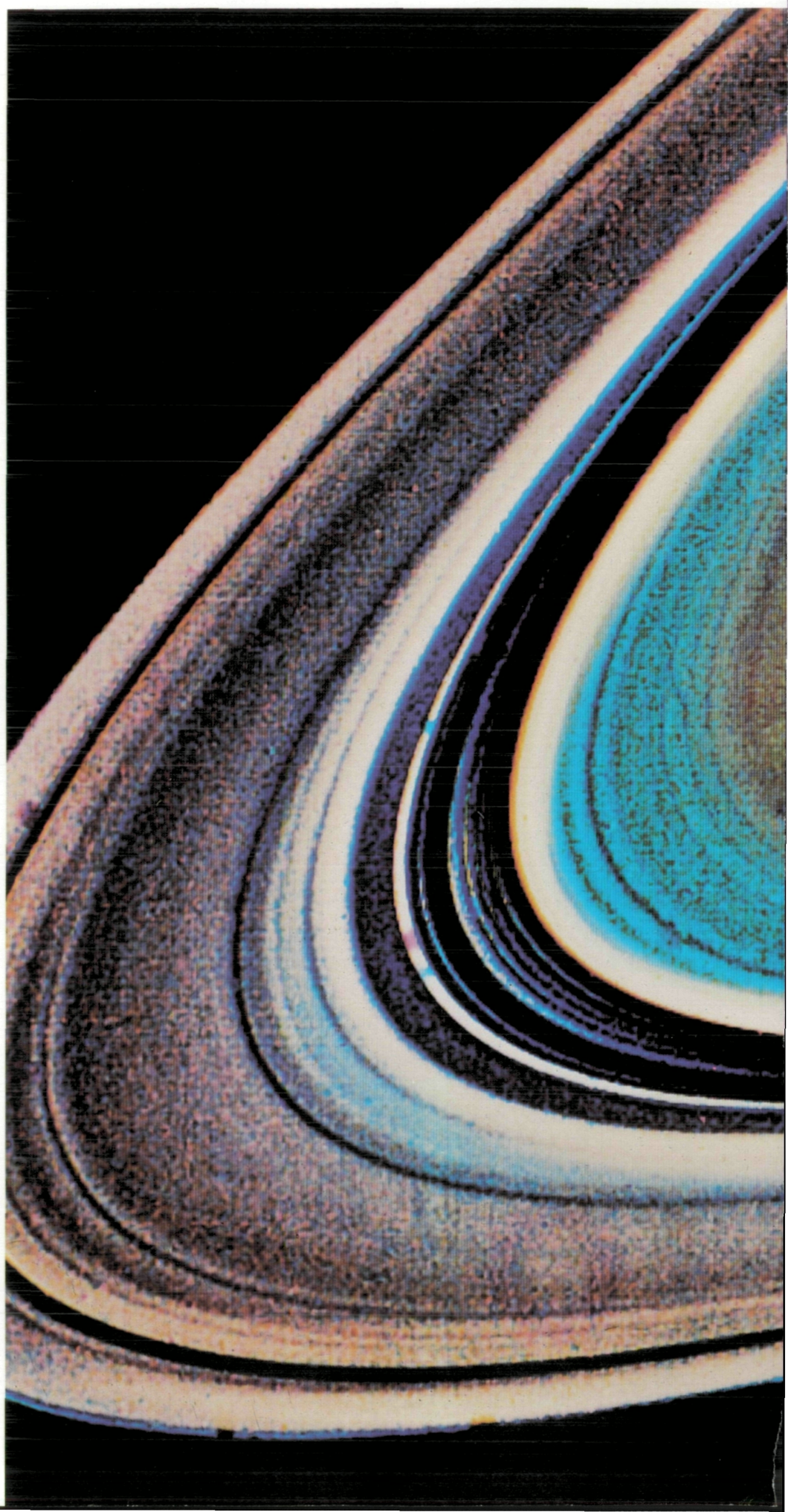

The Colorful Rings of Saturn
The automatic camera on the Voyager 2 spacecraft transmitted this picture of Saturn's rings on August 17, 1981, from a distance of 9 million kilometers (5.5 million miles) from the planet. This highly enhanced color view was made by special computer processing techniques and was assembled from clear, orange, and ultraviolet frames. The color differences among the rings can be accounted for by possible variations in chemical composition throughout the planet's ring system.

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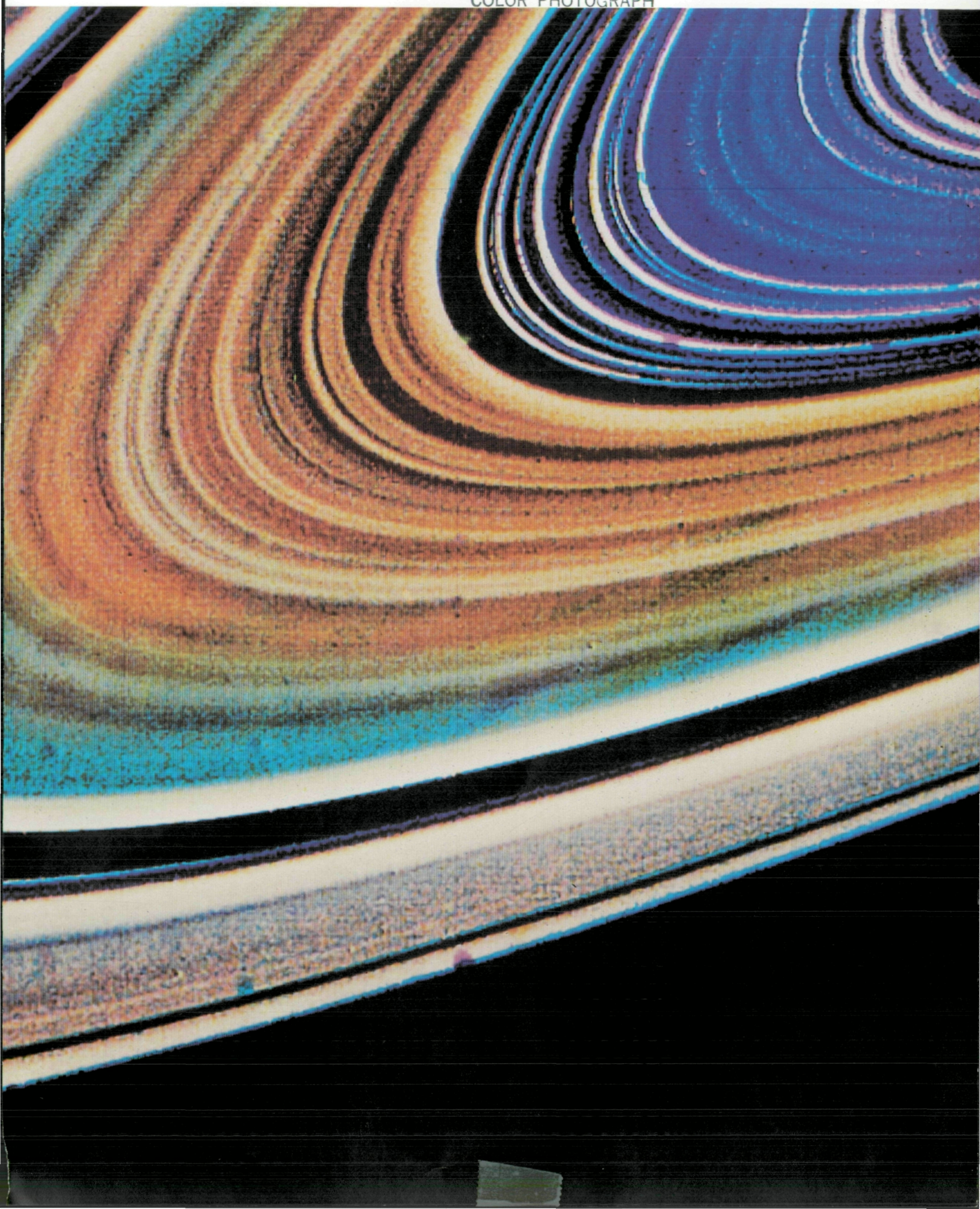

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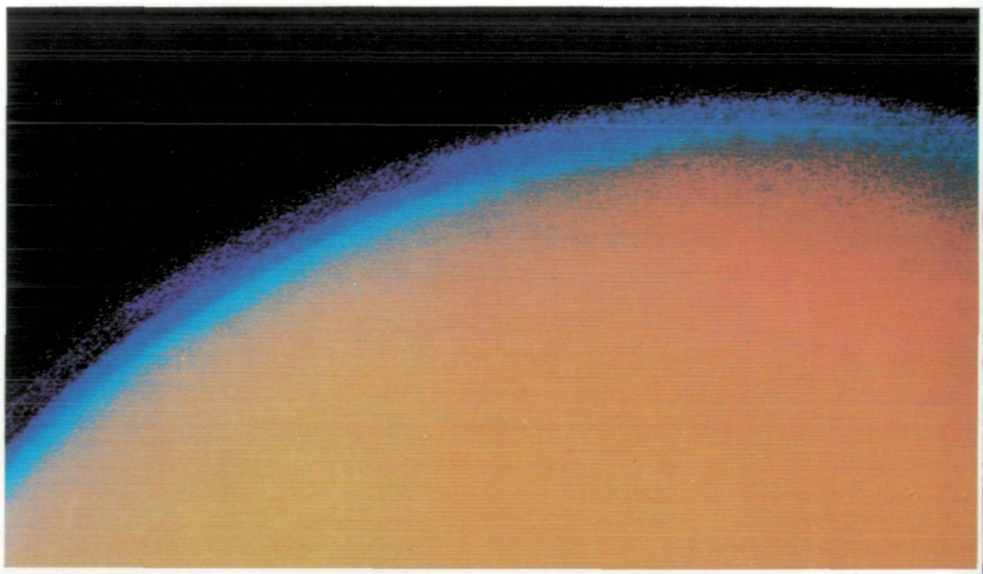
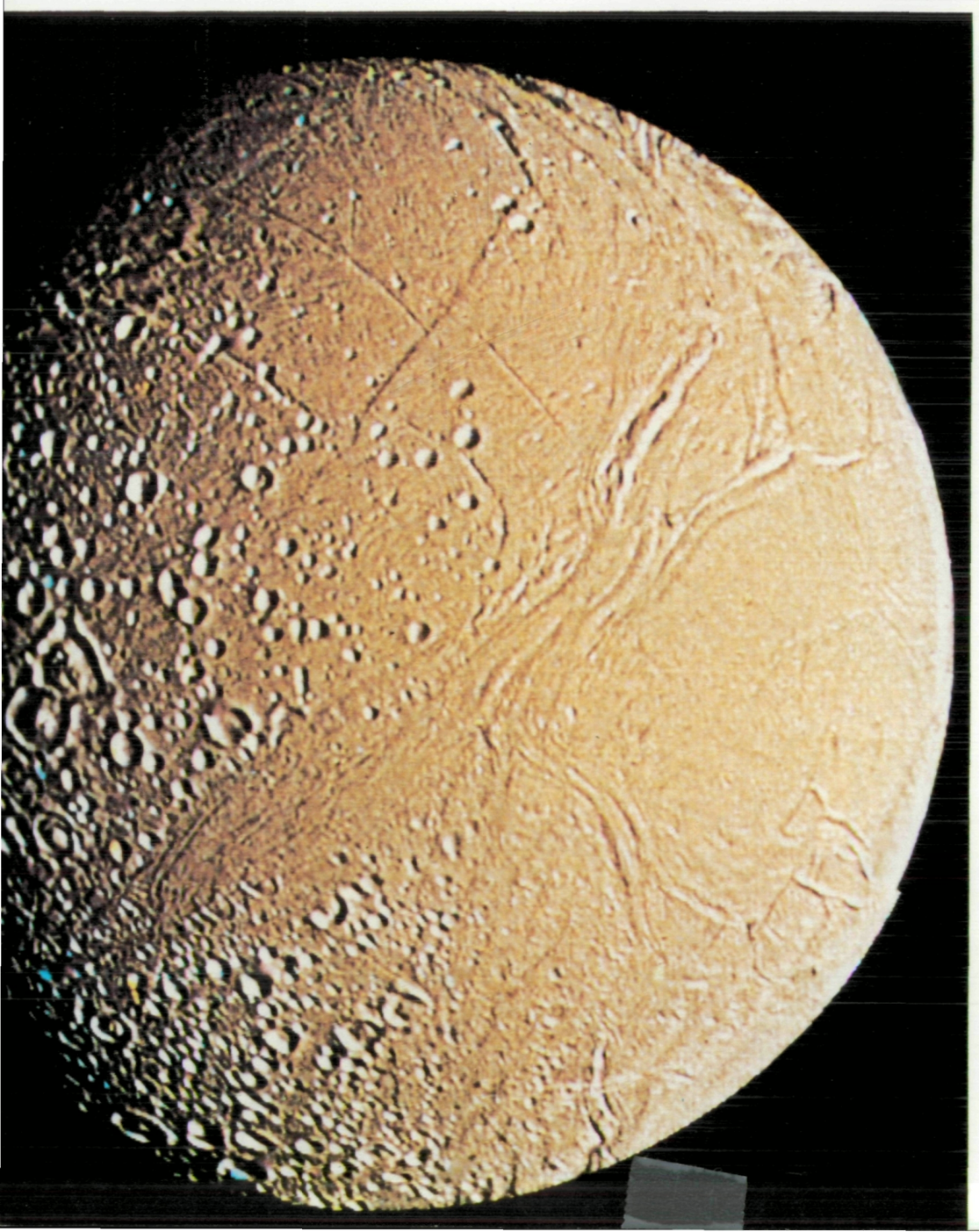
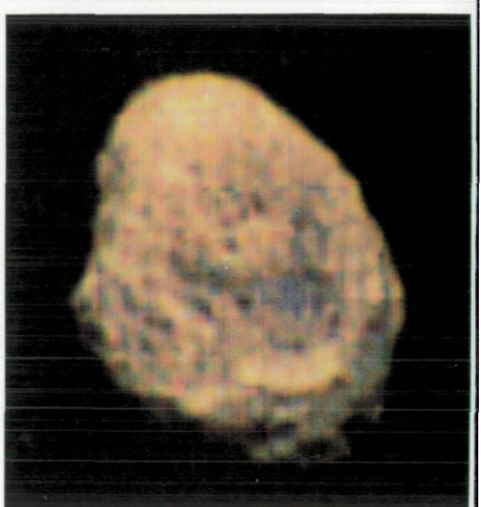
Titan As Saturn's largest Satellite, Titan is shrouded in a dense atmosphere of nitrogen and methane, which form a thick, orange photo-chemical haze.



Enceladus Enceladus is the most geologically evolved Saturnian satellite and has a younger surface with a wide diversity of terrain types. This Voyager photo has been strongly contrast-stretched to bring out surface detail which shows that Enceladus has had a complex geologic history.





Hyperion This satellite of Saturn is one of the most battered astronomical bodies ever seen. It is 410 by 260 by 220 kilometers (254 by 162 by 137 miles). Hyperion is probably the remains of a larger satellite that was destroyed by collision.

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Iceworld The ancient, cratered surface of Saturn's moon Dione may record an intense bombardment by smaller objects (planetesimals) when Saturn and its moons formed. Dione, which is about 1100 kilometers (684 miles) in diameter, is composed largely of ice, though it may have a small amount of denser rocky material scattered through it or forming a small core. The largest crater in the picture is about 100 kilometers (62 miles) in diameter and shows a prominent central peak. White streaks on the left side may be rays of material thrown out of a crater on the other side of Dione. Similar cratered landscapes were photographed on other moons of Saturn—Mimas, Tethys, and Rhea. Dione's surface shows evidence of internal forces as well. A long crack at the lower right near the shadow may have been produced by spreading of the moon's icy crust.

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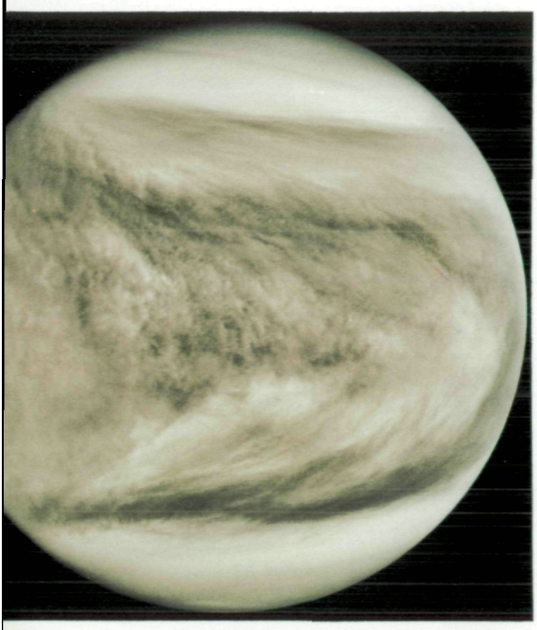
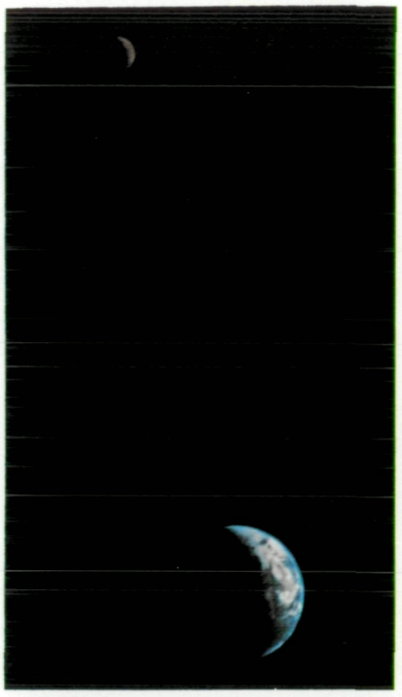
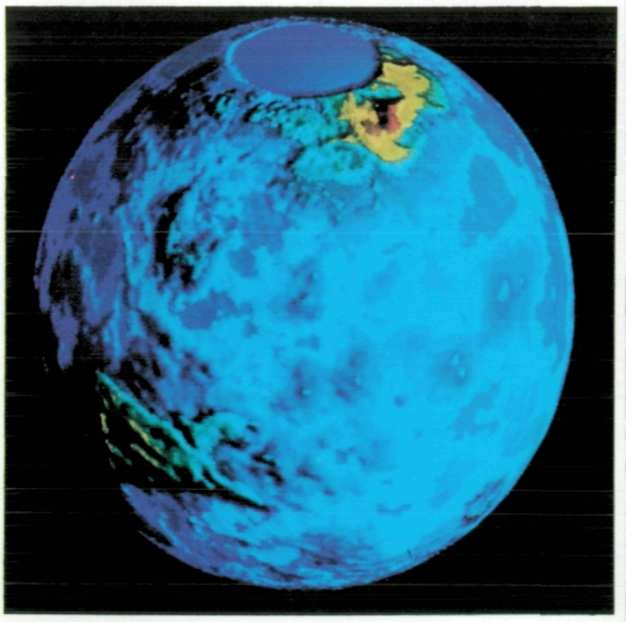


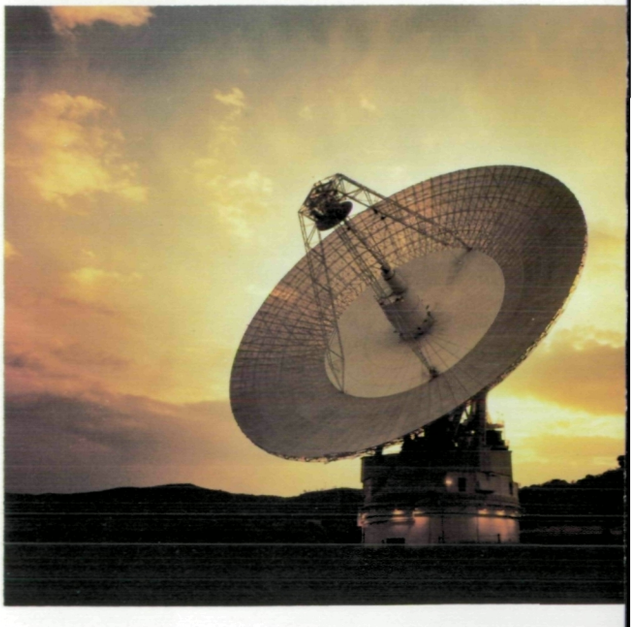
Shrouded Venus This view from space of the planet Venus was taken on December 26, 1980, by the automatic camera on the Pioneer Venus orbiter. The unmanned spacecraft was launched from the Kennedy Space Center at Cape Canaveral on May 20, 1978, by an Atlas-Centaur rocket. It went into orbit around Venus on December 4 of that year and will remain there until sometime in 1986. The orbiter, which at its low point came within 150 kilometers (90 miles) of the surface of the planet, has been evaluating atmospheric samples around Venus and making radar measurements of its surface.

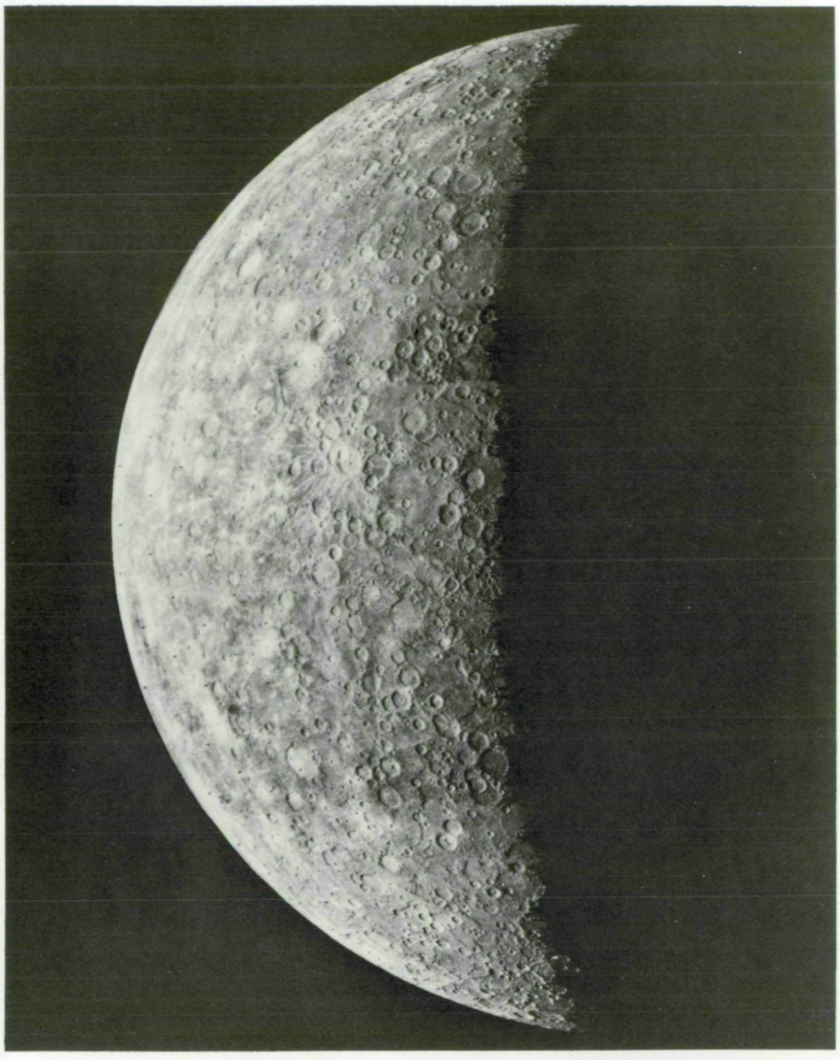


Crescents in Space An automatic camera aboard NASA's Voyager I spacecraft took this picture of the crescent Earth and crescent Moon nearly 11.6 million kilometers (7.25 million) miles from Earth on September 18, 1977. The photograph, which has been computer enhanced in order to bring out the brightness of the Moon, was made from three images taken through color filters, and then processed by the Image Processing Laboratory at NASA's Jet Propulsion Laboratory at Pasadena, California. Voyager I was one of two unmanned space probes launched by Titan III/Centaur rockets from the Kennedy Space Center at Cape Canaveral within a month of each other in August 20 and September 5, 1977. The vehicles reached Jupiter in 1979, and Saturn in 1980 and 1981. The last planetary encounter in the Voyager Program will be in August 1989 when Voyager 2 passes Neptune.

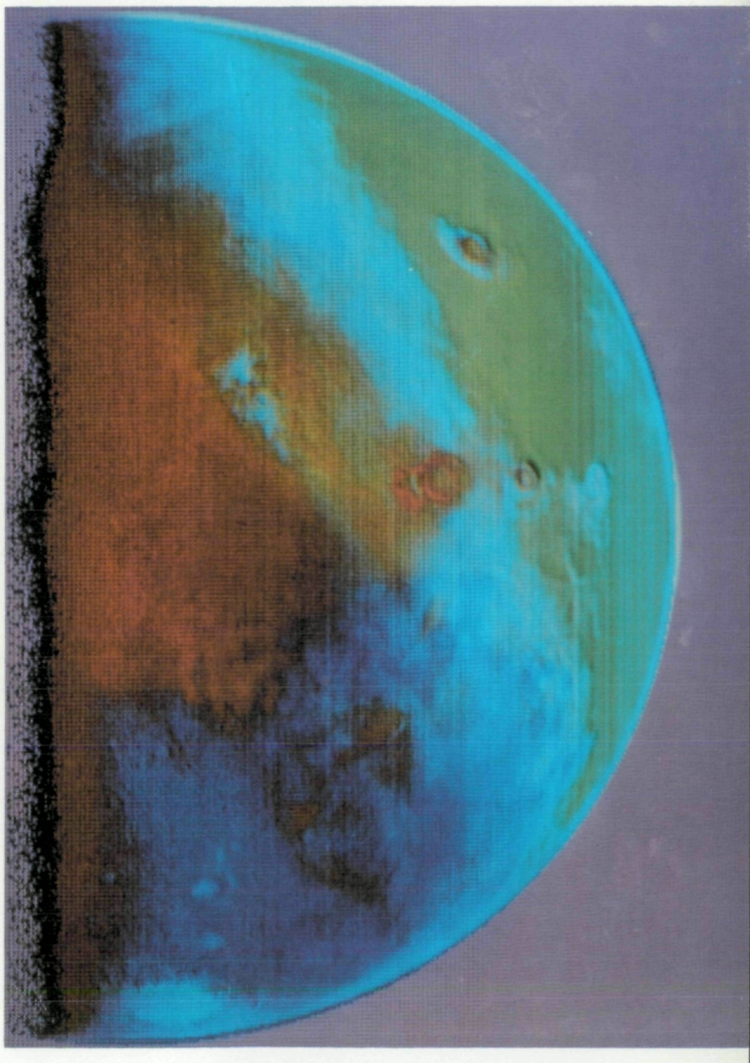


Venus Without Clouds This false color photograph of Venus, stripped of its perpetual cloud cover, was pieced together from radar data transmitted to Earth from the Pioneer Venus orbiter. In this picture, lower elevations are shown in blue, medium in green, and in yellow, the high elevations. Ishtar, Venus' northern continent, is shown at the top of the picture. Below Ishtar, and to its right, is the western end of Aphrodite, the planet's largest continent. At its lowest orbital point, the spacecraft has come within 150 kilometers (90 miles) of the surface of Venus.





Mercury Looking like the pocked landscape of the Moon, this photomosaic of the planet Mercury is made up of 18 pictures taken by the two TV cameras aboard Mariner 10. The photos were taken at 42-second intervals over a 13 minute period on March 29, 1974, while the unmanned probe was six hours and 200,000 kilometers (124,000 miles) from the planet's surface. The pictures were enhanced by computer at the Jet Propulsion Laboratory. The largest of the craters revealed in the photo is approximately 200 kilometers (124 miles) in diameter. Mariner 10 was launched by an Atlas Centaur rocket from the Kennedy Space Center at Cape Canaveral on November 3, 1973. Its mission was to investigate Mercury and Venus, the two closest planets to the Sun.



Tracking Dish Scanning the skies near Madrid, Spain, the DSS-63 communications station is one of three which support all NASA deep space missions. The two other stations in the Deep Space Network are at Goldstone, California, and Canberra, Australia. The Madrid station, the last one to be constructed, cost approximately $17,000,000 and became operational in September 1973. The great disk is 65 meters (213 feet) in diameter.

Mars in False Color This false color exaggeration of the true color variations found on Mars was made by computerized image processing of a photograph transmitted to Earth by the automatic camera on the unmanned Viking I spacecraft (prior to its soft landing on Mars on July 20, 1976). The false color method enables scientists to separate and amplify extremely subtle color differences among various types of clouds, atmospheric hazes, surface frosts and rock materials. The giant Martian volcanoes, for example, are shown in dark red. The broad band of atmospheric haze is shown in bluish-white.

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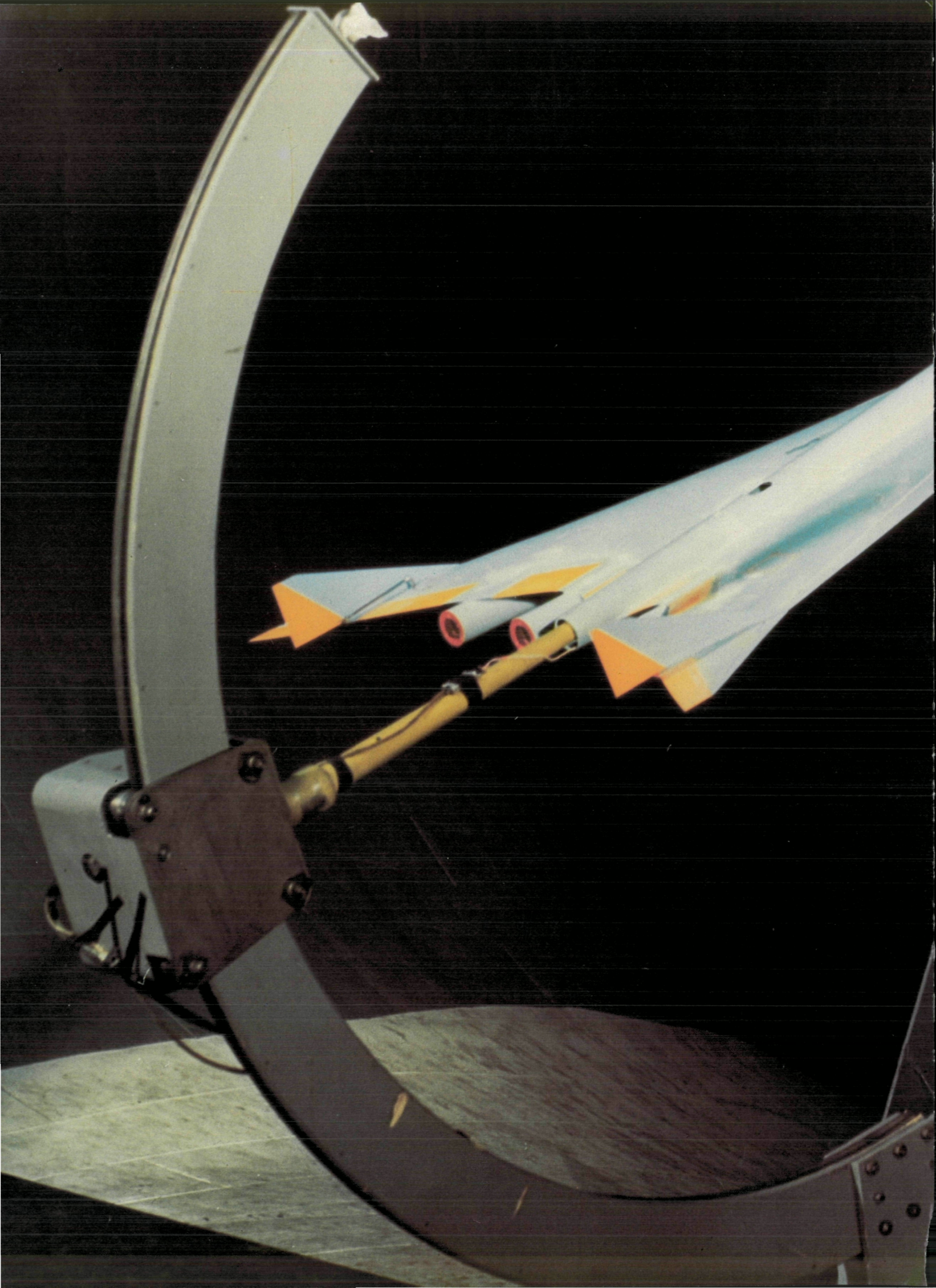
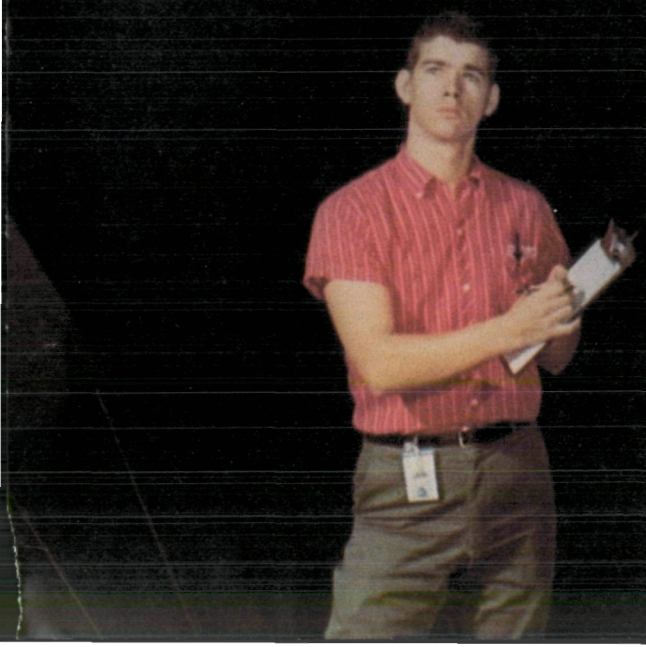


AERONAUTICAL RESEARCH

Not all of NASA's efforts are oriented to space flight. The agency has devoted a large portion of its resources to aircraft research and development. The X-15 rocket planes of the Sixties, three important NASA research aircraft, held the speed and altitude records for winged aircraft until the space shuttle Columbia made its first flight in 1981. The X-15s, and the mammoth XB-70, which was a joint NASA-Defense Department project, contributed valuable data pertaining to supersonic flight.

With the growing interest in short-distance commuter aircraft, planes which can use limited-length runways and helicopter technology, NASA technicians at the Dryden Flight Research Facility at Edwards, California, and the Langley Research Center at Hampton, Virginia, are testing and evaluating aircraft designs with a view toward the development of more efficient engines, propellers and wings. At these facilities, researchers use equipment ranging from actual aircraft to aircraft models, some no more than an inch long, in wind tunnels which can simulate virtually any atmospheric condition a plane in flight may encounter. The data is made available to industry and other government agencies.



Wind Tunnel Scale Model
Scale model of NASA's latest supersonic transport concept, SCAT 15F, poised for force tests in the Full-Scale Wind Tunnel at Langley Research Center, Hampton, Virginia. Later, the model will be "flown" in the test section of the same wind tunnel to assess its dynamic behavior and stability in flight. The letters SCAT refer to Supersonic Commercial Air Transport.

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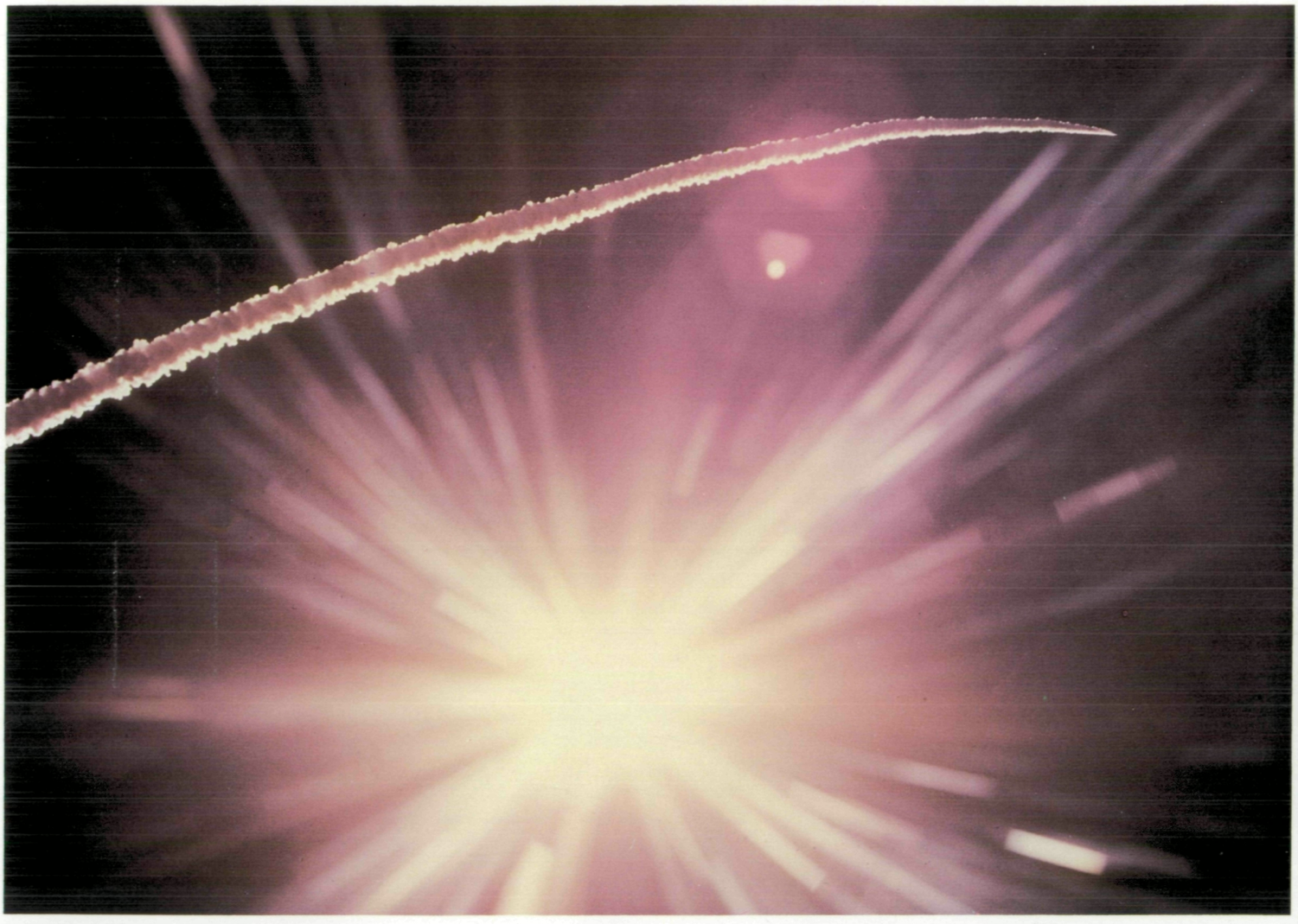
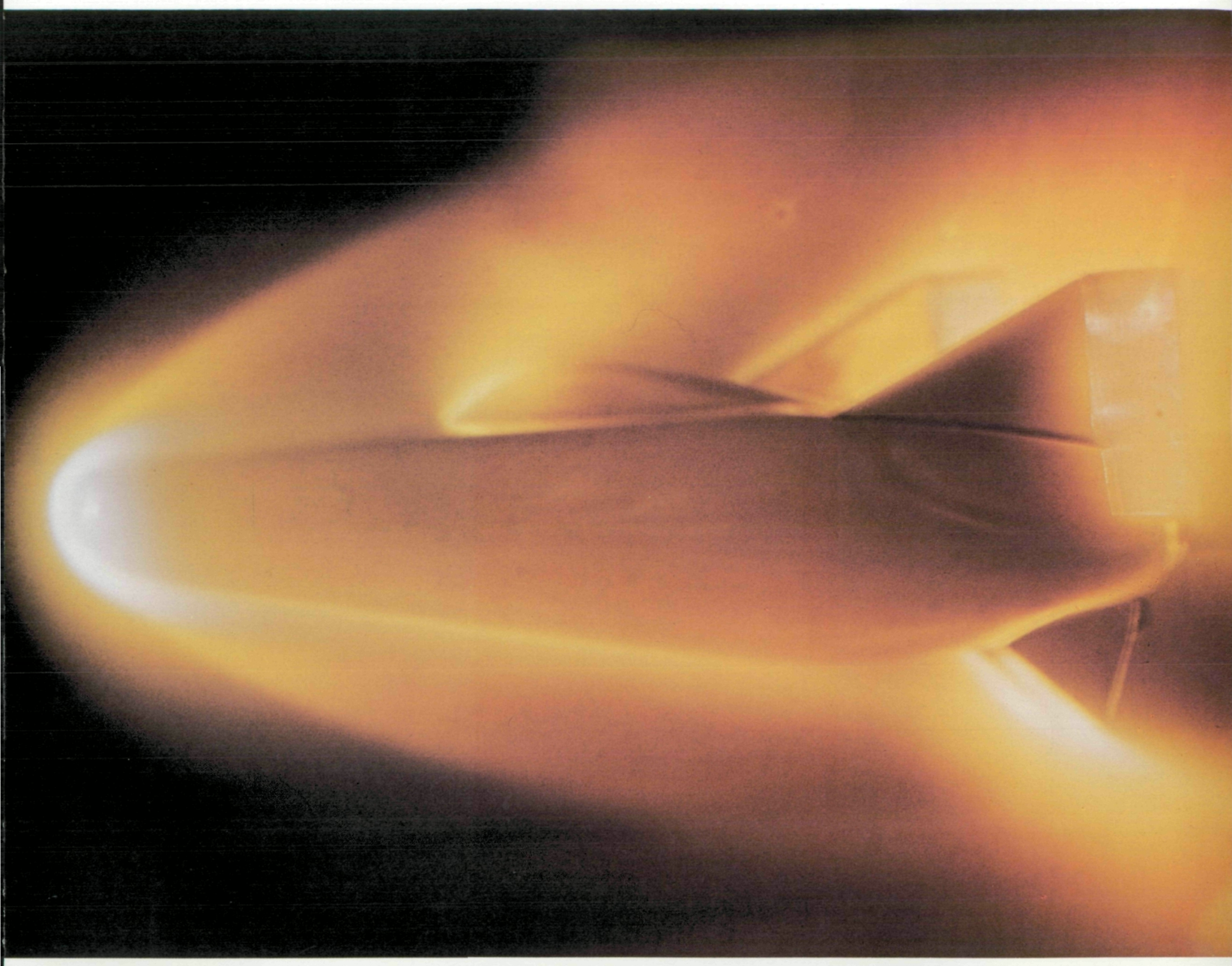
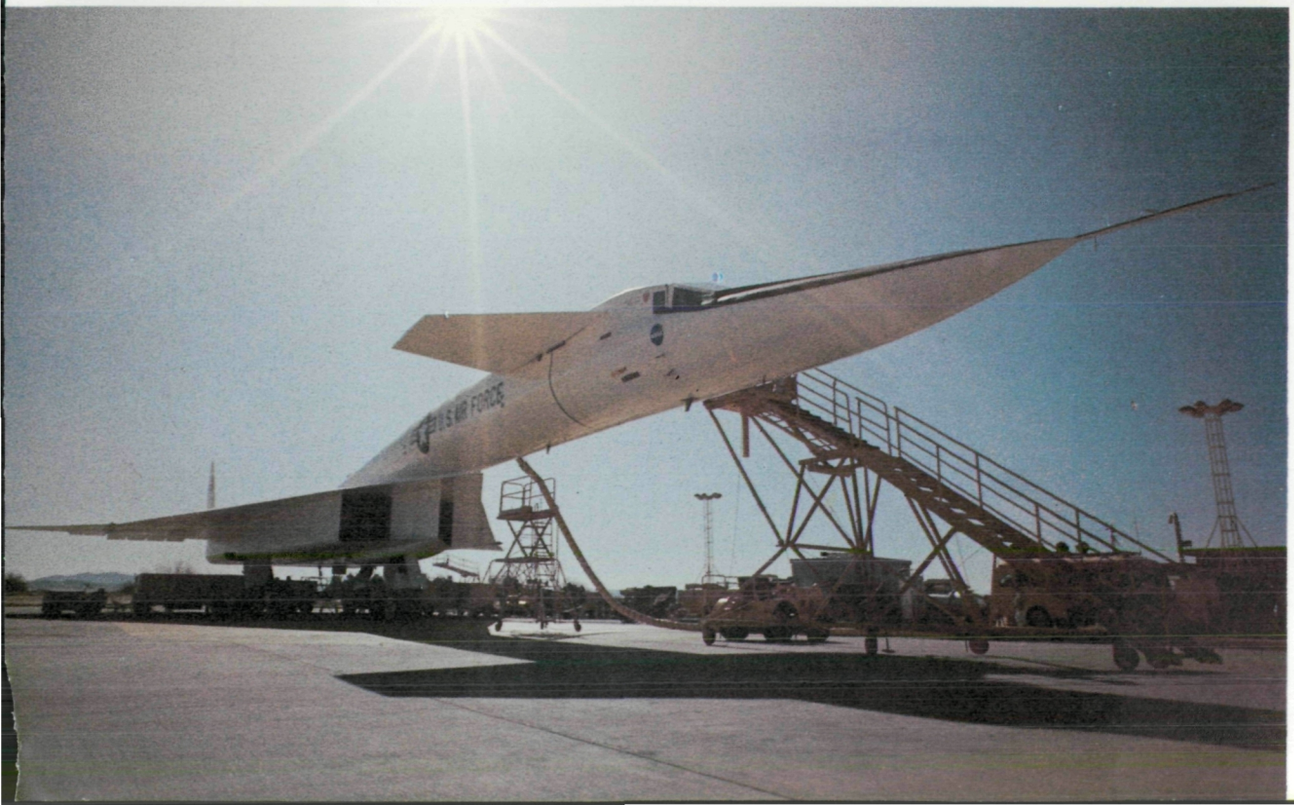
Wind Tunnel Experiment A wingless maneuverable space vehicle is being proved feasible during this test conducted in a foot-long hypervelocity wind tunnel at NASAs Ames Research Center at Moffett Field, California, in February 1963. The glowing model is shown being subjected to an air-flow of 4,300 meters (14,000 feet) per second, which is producing temperatures of about 9,000 degrees (F) at the model's nose. Temperatures well in excess of that amount would be experienced by a vehicle traveling at hypersonic speeds at high altitudes.



Skystreak High over California's Mohave desert, an X-15 rocket plane releases a plume contrail after being released from a B-52 mother aircraft.

XB-70 Making its first flight exclusively under NASA control, the huge XB-70 is readied for take-off on April 25, 1967, at Edwards Air Force Base, California. Rockwell International Corporation built just two of the unusual looking aircraft, which could fly at speeds of up to 2,000 mph. Used in a joint NASA-Department of Defense flight research program, the XB-70 made its first flight in September 1964. The Defense Department evaluated the plane as a possible successor to its B-52 bomber, while NASA used the XB-70 for research pertaining to supersonic flight. Both planes few 128 test and research missions. In June 1966, one of the XB-70 aircraft was lost in a mid-air collision. The remaining one made its last flight in February 1969 to the air museum at Wright-Patterson Air Force Base, Ohio.





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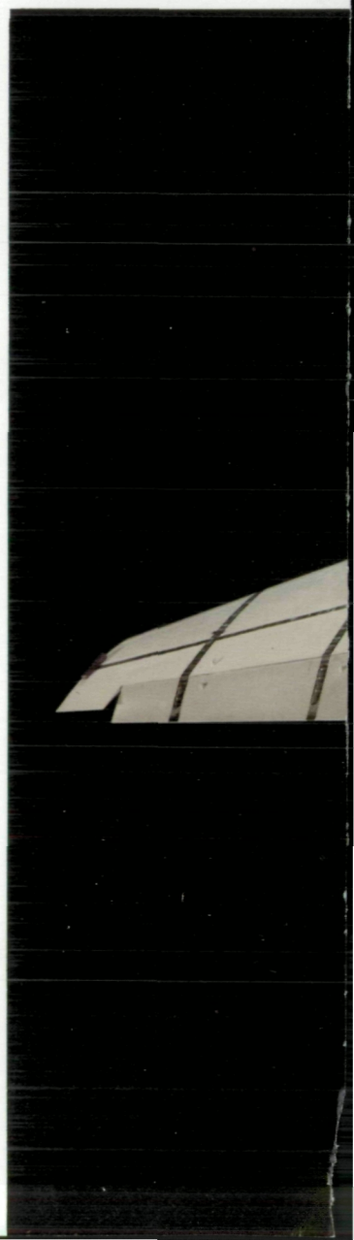
Oblique Wing Concept Tested
The Ames-Dryden-1 (AD-1), photographed during a test flight from NASA's Dryden Flight Research Center, is being flown to study the concept of the oblique wing. Invented by Ames Research Center scientist Robert T. Jones, the oblique wing is pivoted at a central point. Rotated by actuators, one wing tip moves forward and the other aft to sweep angles up to 60 degrees with the fuselage centerline.



Aircraft Winglets Improve Flight
The winglet pictured is an aerodynamic innovation designed to improve fuel consumption and generally improve airplane performance.

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COLOR PHOTOGRAPH

Vertical Takeoff and Landing Supersonic Aircraft Concept for an advanced fighter is shown before testing in an Ames Research Center wind tunnel. The fighter model is intended to have vertical or short takeoff and landing capability, and uses thrust vectoring to achieve that goal. The exhaust from twin General Electric J-79 turbojets is directed over the wing flaps to increase their lift increment for short-field performance. Later, a thrust augmentation system will be added to increase the available thrust and achieve vertical takeoff. This particular model is three-quarters full-scale, and was mounted for low-speed tests in the Ames tunnel facility.

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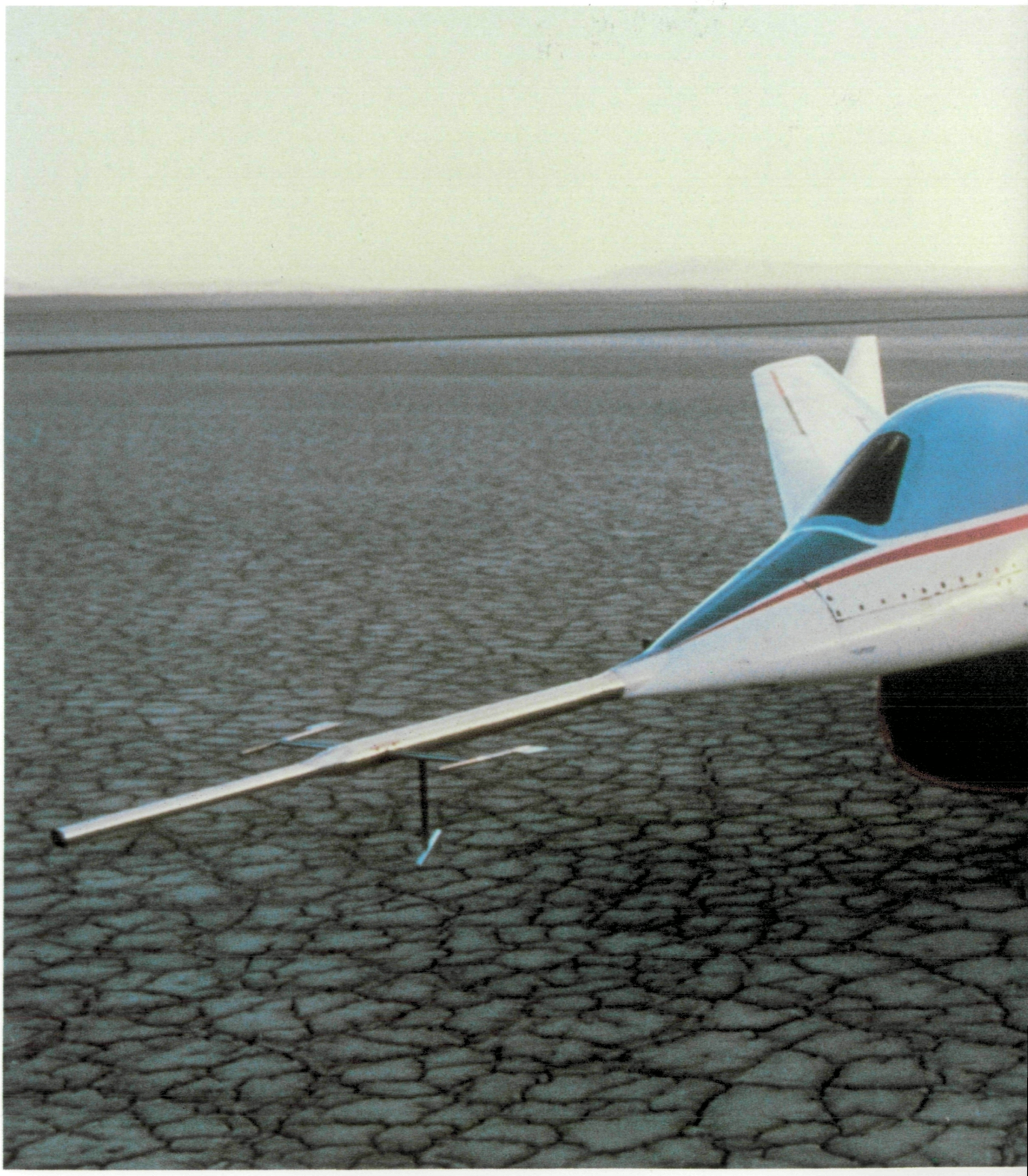
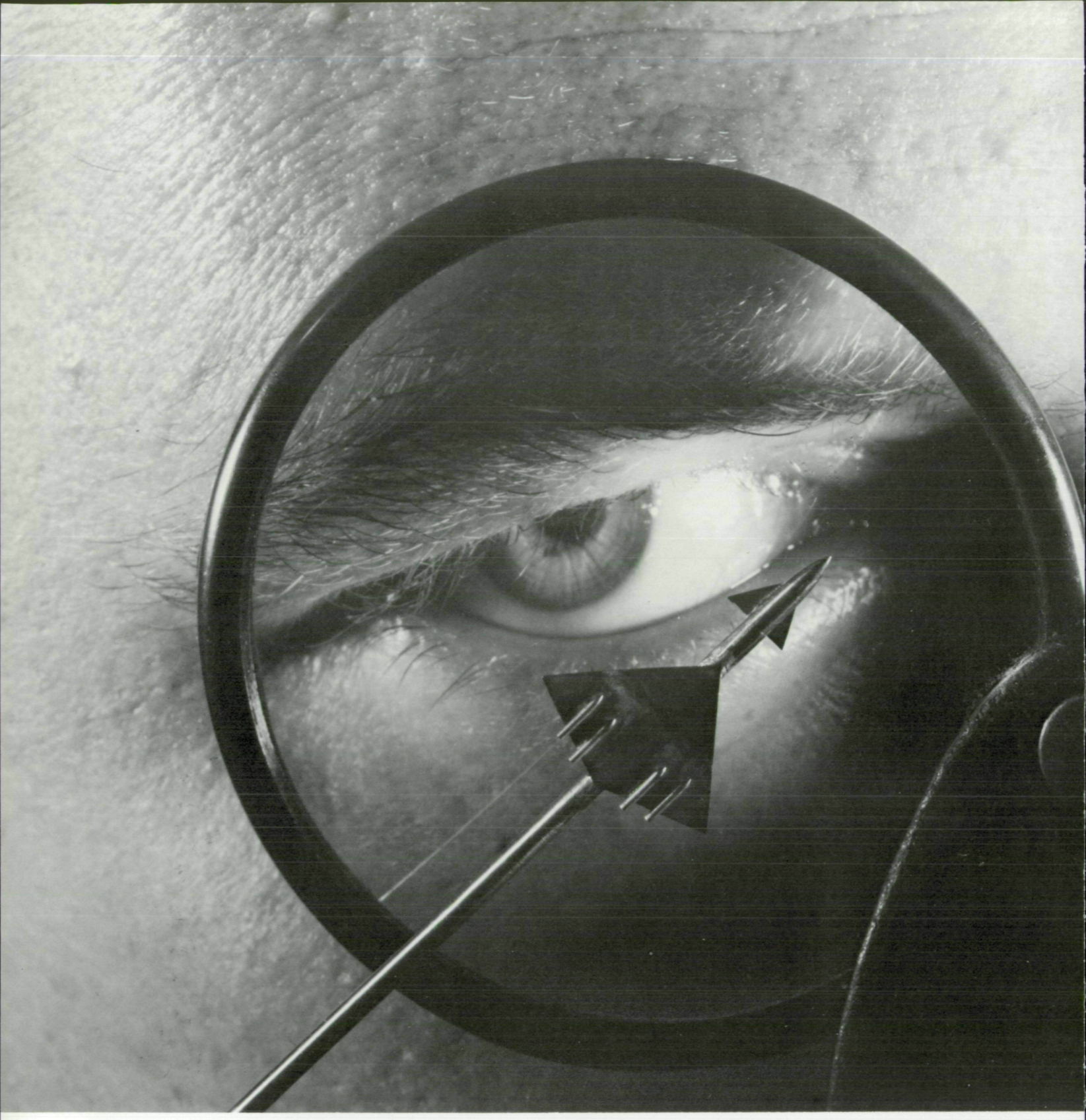


HiMAT, for Highly Maneuverable Aircraft Technology The HiMAT test craft shown, one of two built by Rockwell International, is an unmanned remotely piloted research vehicle which is air-launched from a B-52 carrier plane and "flown" by a pilot on the ground. This concept allows high-risk testing without risk to human life and also reduces vehicle costs normally associated with provisions for pilot occupancy and safety. Designed in modular fashion, HiMAT can be readily modified to incorporate new technologies.



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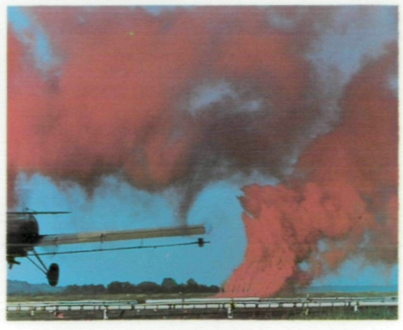

Close Examination NASA photographer William Taub photographed this one-inch scale aircraft model being closely scrutinzed by an engineer at NASA's Langley Research Center at Hampton, Virginia The tiny model, which is representative of a typical supersonic aircraft design, is about to be placed inside a four-foot-long wind tunnel which can simulate altitudes of up to 40,000 feet. Pressure fields created within the tunnel, and their effect on the model plane, will help NASA to evaluate the designs of future supersonic aircraft, particularly with regard to the sonic boom phenomenon.

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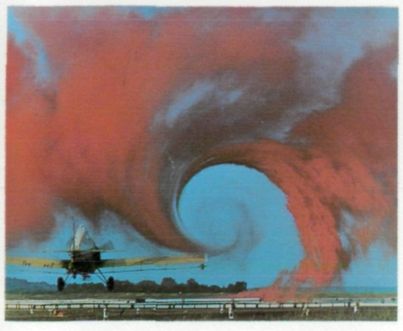
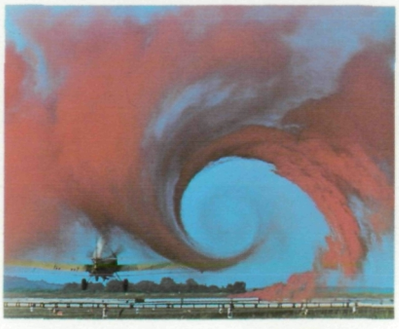
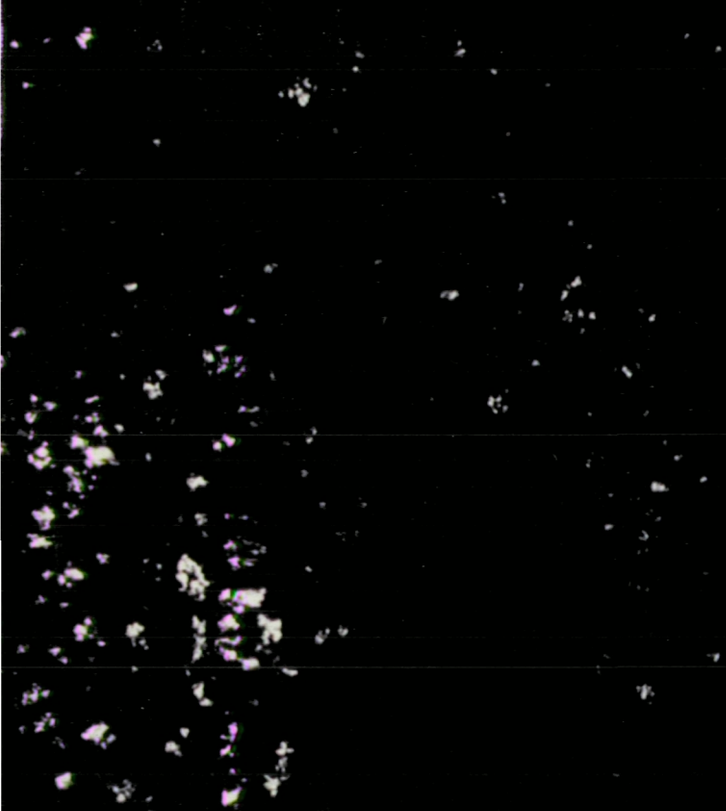
S-15 Roll-Out A modified X-15, carrying external fuel tanks, is rolled out of North American Aviation's Los Angeles factory in this February 1964 photograph. The additional fuel tanks will increase the engine burning time to 145 seconds at full throttle, which will raise the aircraft's speed by as much as 130 mph. The X-15 was a joint NASA-Air Force-Navy aeronautical research program, which involved three X-15 aircraft that made a total of 199 flights between June 1959 and October 1968. Until the first flight of the space shuttle Columbia in 1981, the X-15 held the altitude for winged aircraft, with some flights as high as 354,000 feet at speeds of 5,520 mph, which is over six times the velocity of sound.

Red Vortices A visually striking red smoke spiral is the result of smokescreen penetration by an Ayers Thrust S2R-800 agricultural aircraft at NASA's Wallops Island (Virginia) Flight Center on June 25, 1981. The aircraft and smoke screen, which was created by igniting a smoke generator inside a 10-foot long enclosed tube, punctuated with holes, were part of a test conducted by NASA for the aerial application industry. The test was designed to see how to make aircraft wake vortex work for more efficient and safer aerial deposition of chemicals. The drift of toxic materials away from target sites is one of the serious problems facing those who spray chemicals from the air for agricultural or other uses. From the tests, methods are being developed to obtain more favorable uniform spray patterns and to reduce chemical drift.





EARTH ORBIT APPLICATIONS

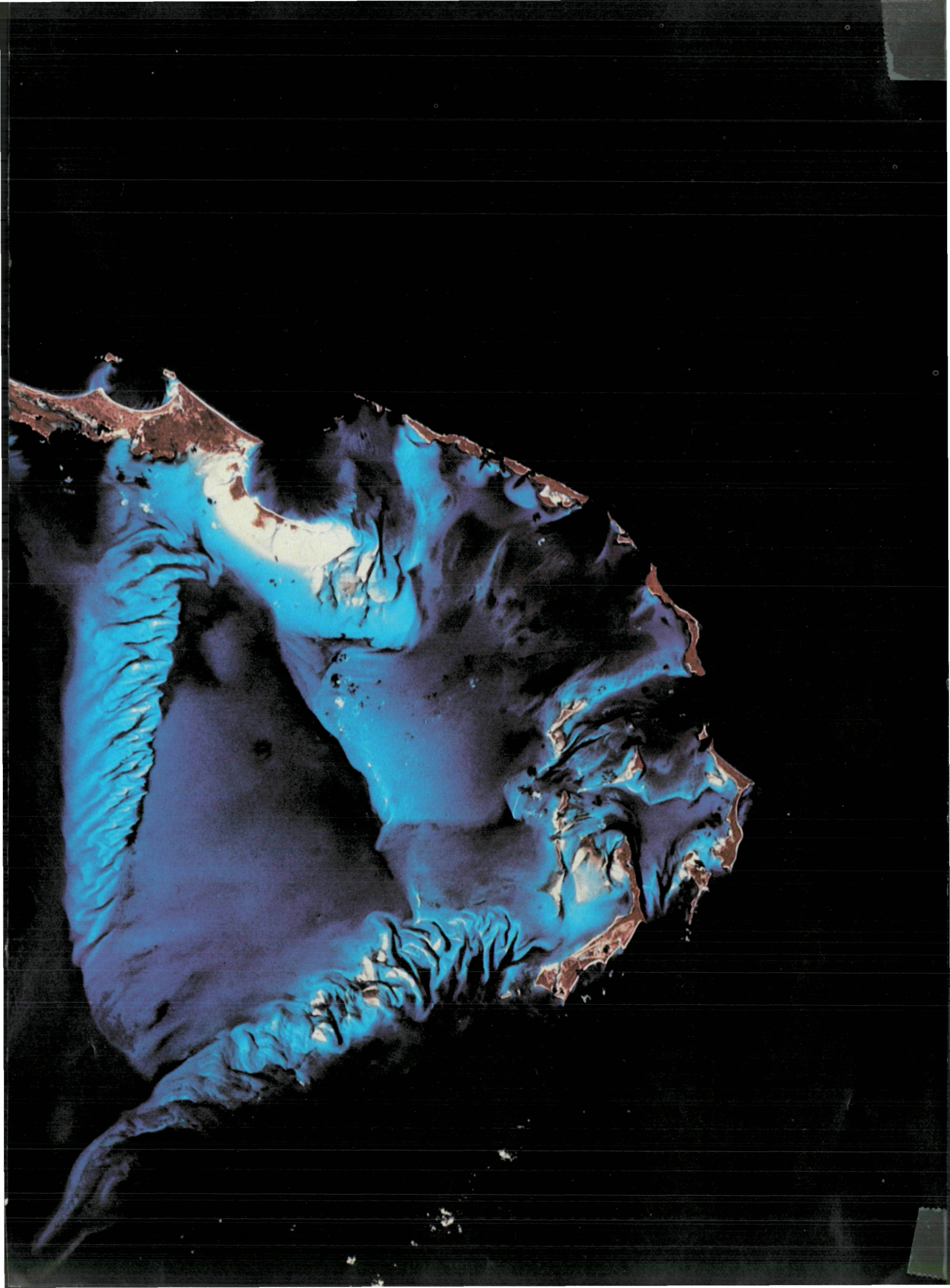


With the launching of the ERTS-A satellite on July 23, 1972, NASA became an important factor in the study of the Earth and its resources. ERTS-A, and the subsequent Landsat satellite series, of which Landsat 4 is the latest, have been transmitting data to Earth which has become invaluable in mapping and land-use studies.

Among the uses of the data coming from the Landsat vehicles has been the potential location of mineral resources, topographical information and crop surveys. Landsats have also pointed out areas of insect infestation and, by evaluating snow accumulation, have helped to predict more accurately areas in greatest danger of flooding during spring run-offs.

Information disseminated by the Landsat program has been used throughout the world by more than 100 countries. The satellites, which are orbited by NASA, are managed by the National Oceanic and Atmospheric Administration, an agency of the United States Department of Commerce.

Skylab Photo of Bahamas This photo of the Berry Islands, Great Bahama Bank was taken during the Skylab 3 mission. The astronauts were launched from NASA's Kennedy Space Center, from Complex 39B on July 28, 1973. The crew, Astronauts Alan L. Bean, Mission Commander; Owen K. Garriott, Scientist/ Pilot; and Jack R. Lousma, Pilot, splashed down September 25, 1973 about 362 kilometers (225 statute miles) southwest of San Diego, Calif.



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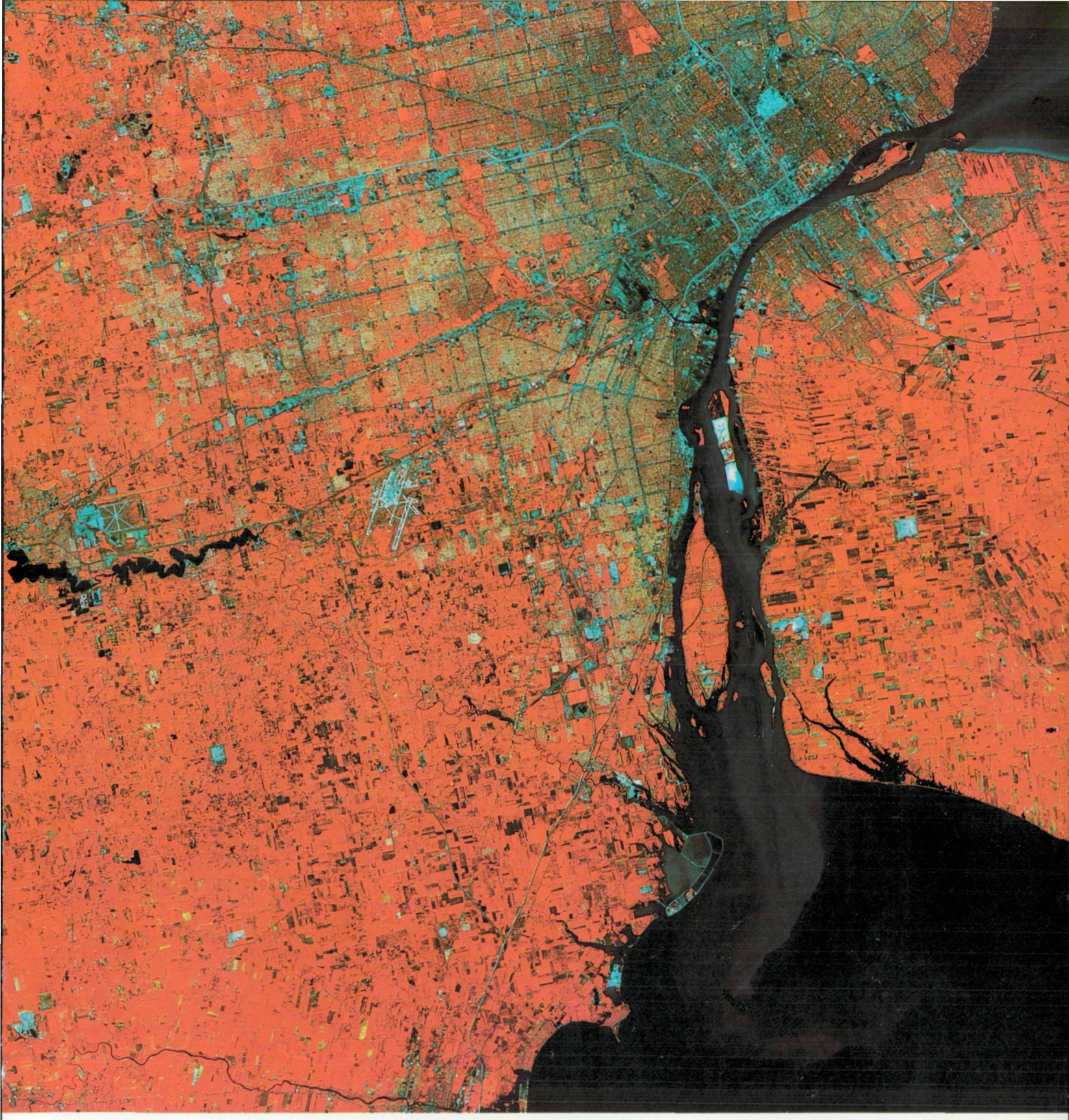
Space Shuttle Radar Mapping
Secrets of the Sahara, hidden by sand, are revealed by the piercing eyes of radar.

Probing the sand to a depth of six meters (20 feet), the shuttle's radar, developed by scientists at the Jet Propulsion Laboratory (JPL), literally fills in the space between the lines to reveal ancient topographical features in the northwestern Sudan.

The dark region at top has been identified as a river valley as large as that of the present-day Nile. Below it other riverbeds and valleys carve the bedrock. In a similar area in Egypt, scientists dug along a riverbed revealed by radar and discovered arrowheads 100,000 to 200,000 years old.



Landsat 4 Mapping Landsat 4's imaging systems provide a picture of Detroit, Michigan and environs from an altitude of 440 miles.

To make this photograph, three of the satellite's seven imaging systems were employed—red and green in the visible-light wavelengths and infrared in the near visible portions of the spectrum.

Detroit, at upper center, and Windsor, Ontario, are separated by the Detroit River. At left center, Highway 94 skirts the runways of Metropolitan Wayne County Airport and, farther west, threads between Lake Belleville and the runways that appear as spokes in the Willow Run Airport.

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New England View From Landsat The thematic mapper on the Landsat 4 satellite transmitted this natural color photograph of the Boston, Providence and Cape Cod areas of New England on September 10, 1982. The picture was taken 705 kilometers (438 miles) above Earth. The white portions of the photograph clearly indicate the major cities of the region. One of four Earth mapping satellites, Landsat-4 was launched into Earth orbit on July 9, 1982, from the Western Space and Missile Center at Vandenberg Air Force Base, California, by a Delta rocket. The satellite is under the operational management of the National Oceanic and Atmospheric Administration of the Department of Commerce. More than 100 nations have made use of Landsat data in their resource development and management programs, and 11 countries have their own capability to receive and process information directly from the satellite.

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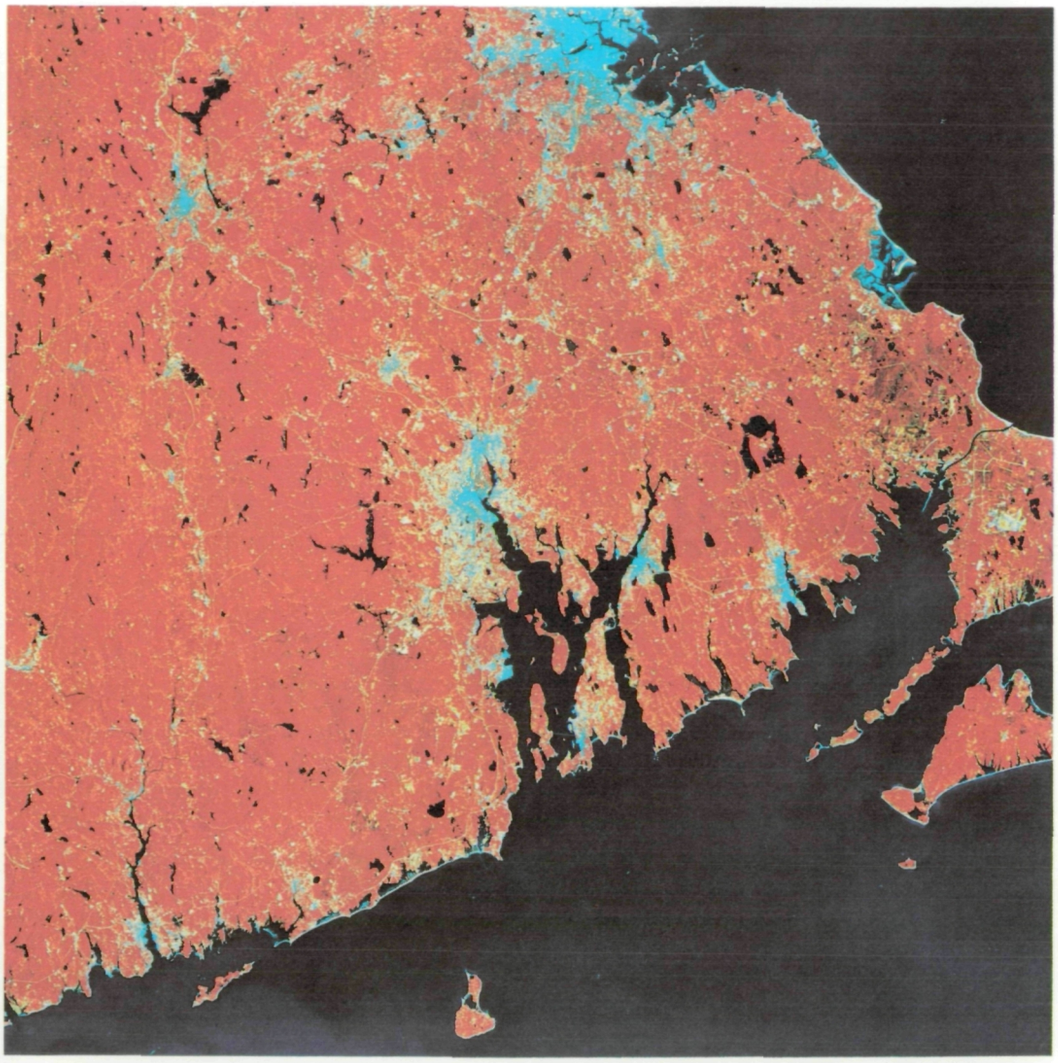

Boston, Providence and Cape Cod This infrared photograph of the same area of New England was also transmitted by the thematic mapper aboard the Landsat-4 satellite on September 10, 1982. The bluish-white areas are heavily populated communities, in which there is little vegetation. Areas of heavy vegetation, on the other hand, are shown in red.

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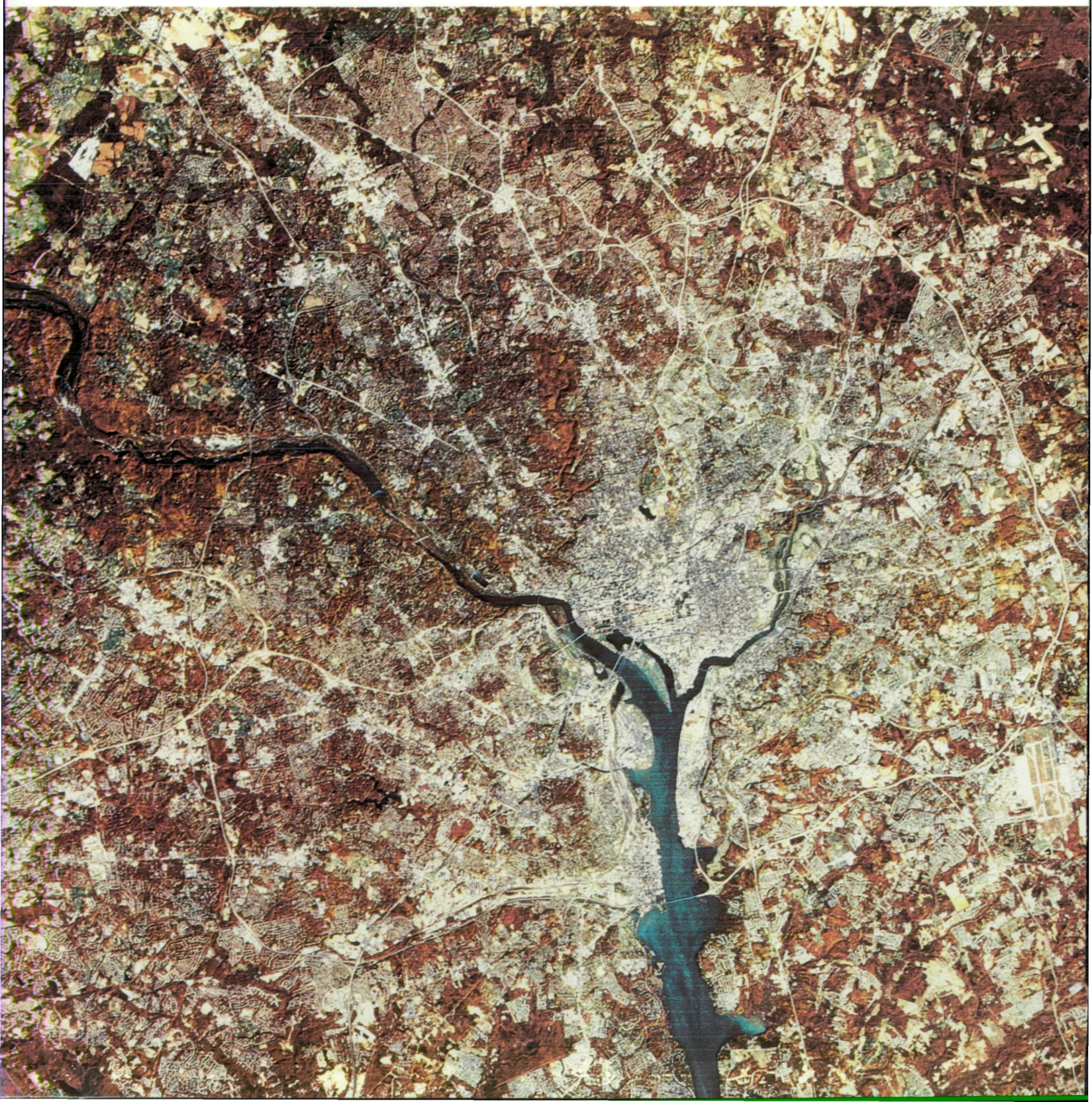
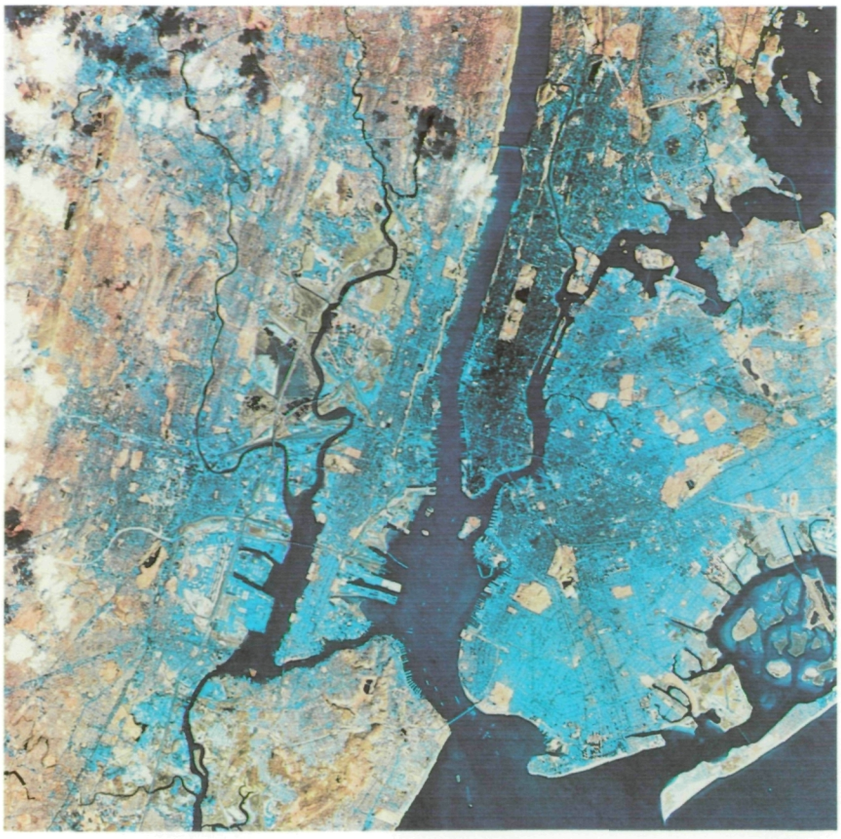
Autumn View of Washington
The thematic mapper on the Landsat-4 recorded this scene of Washington, D.C. on November 2, 1982. The natural color scene, taken from 705 kilometers (438 statute miles) above the Earth, renders the large government buildings clearly discernable.





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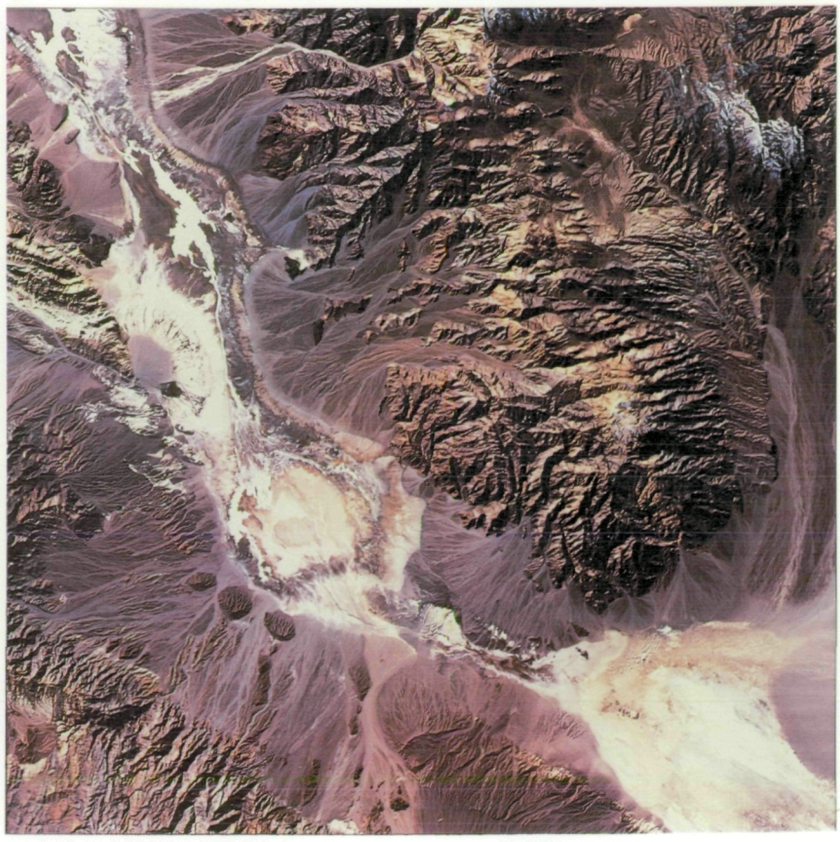
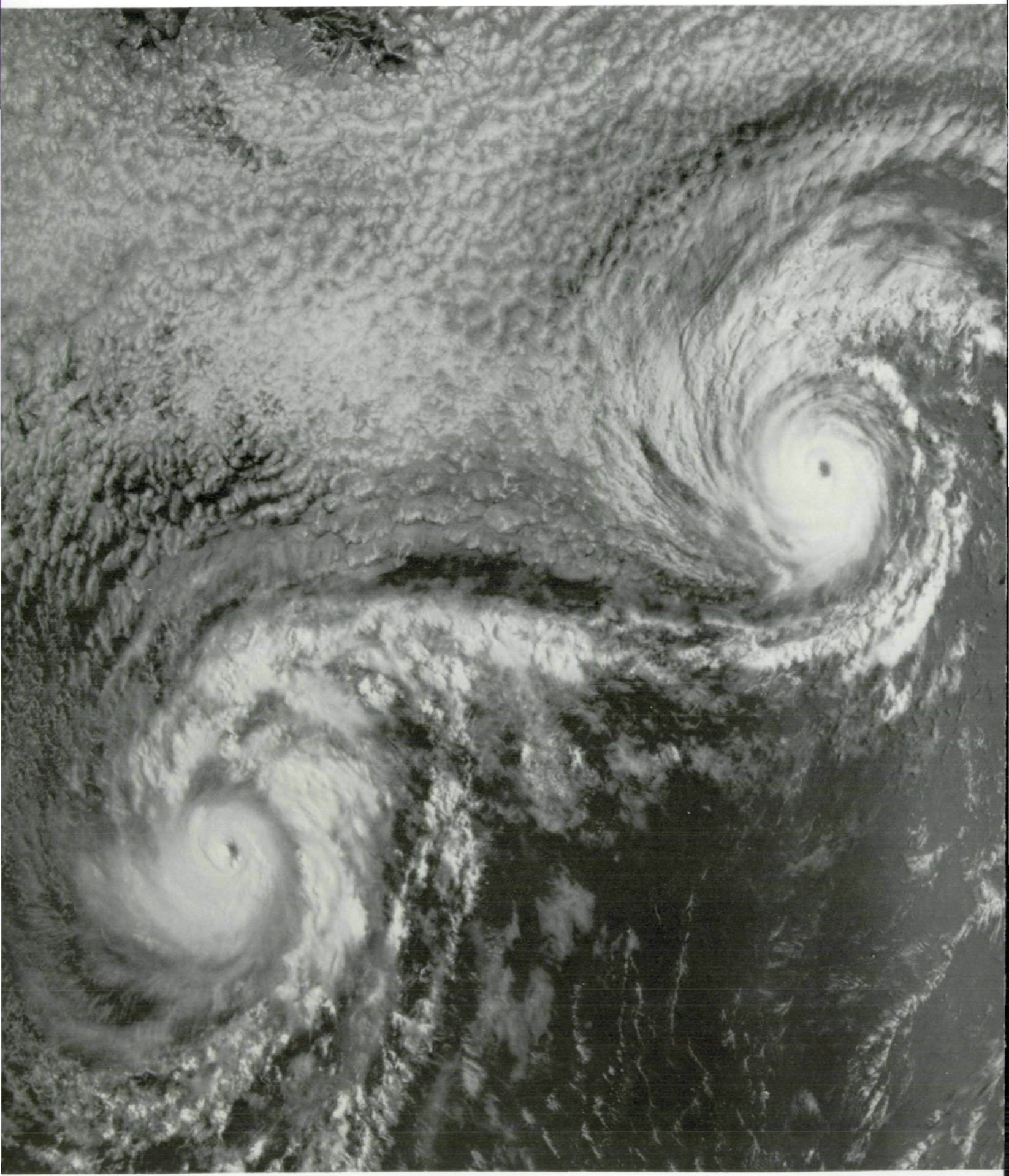
Metropolitan New York This infrared view of the New York Metropolitan area was recorded by the thematic mapper on the Landsat-4 satellite in February 1983. Most of the well-known landmarks, such as the Statue of Liberty and the piers along the west side of Manhattan, as well as Central Park, can be seen. The five boroughs of New York are clearly visible.

Death Valley The thematic mapper on the Landsat-4 satellite transmitted this photograph of Death Valley, California, from 705 kilometers (438 statute miles) above the Earth.





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Pacific Hurricanes The orbiting ITOS-A weather satellite electronically photographed the twin hurricanes Ione and Kirsten on August 24, 1974, as they whirled over the Pacific Ocean about 1,600 kilometers (1,000 miles) west of the Mexican state of Baja California. The two storms, which never came ashore, were about 970 kilometers (600 miles) apart when this photograph was taken. ITOS-A was launched by NASA for the National Oceanic and Atmospheric Administration on December 11, 1970, by a Delta rocket from the Kennedy Space Center at Cape Canaveral.

Ice Covered Lakes The automatic camera on the Tiros-N satellite captured this image of the Eastern portion of the United States on February 17, 1979. The picture clearly shows the East Coast of the United States from just south of Virginia through the State of Maine. The DEL-MAR-VA Peninsula, Long Island and Cape Cod are visible along the Coast. The Great Lakes, which appear in the middle of the photograph, are almost 90 percent covered with ice. Tiros-N is a NOAA weather satellite which was placed in a polar Earth orbit on October 13, 1978.

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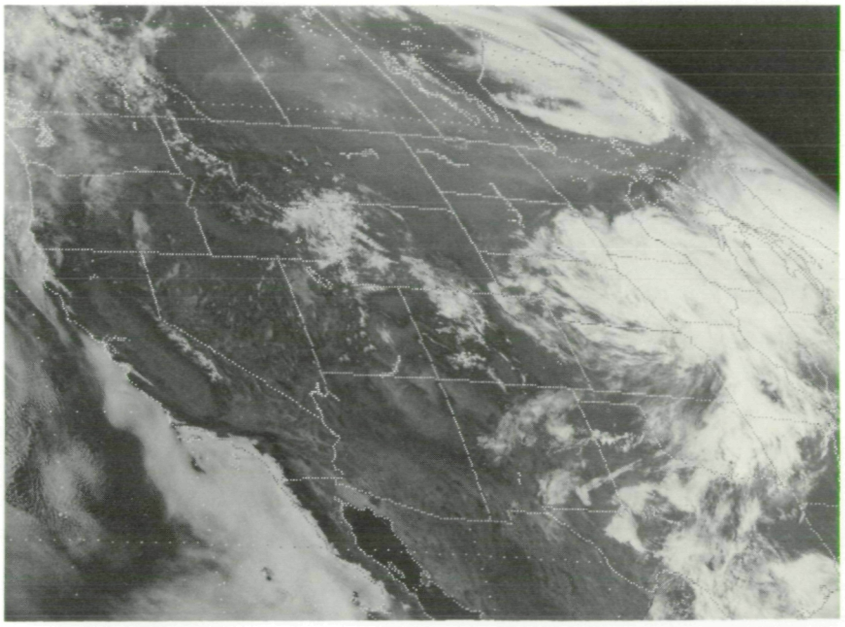
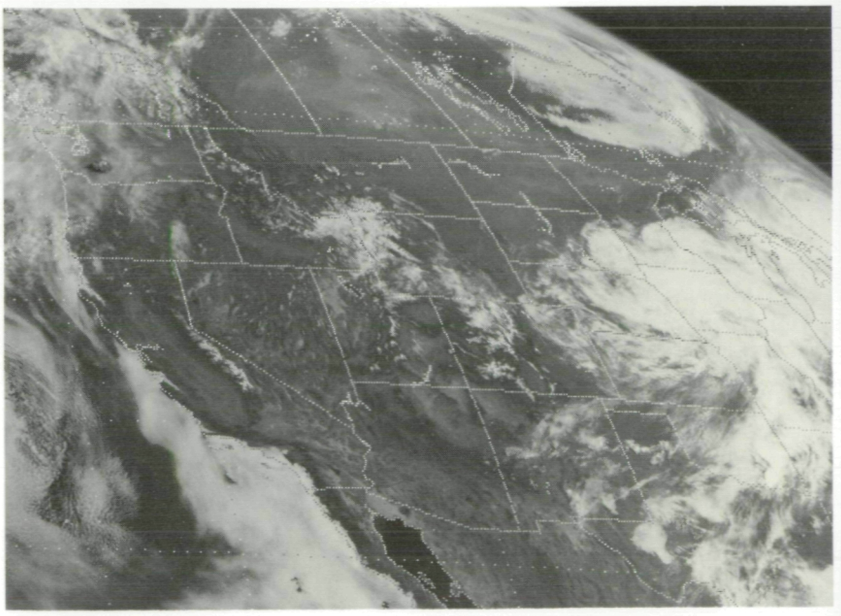
The Eruption of Mount St. Helens These five photographs, which were taken over a three-hour period from 8:15 AM to 11:15 AM Pacific Daylight Time from the GOES-West spacecraft, detail the start of the disasterous eruption of Mount St. Helens in Washington State. A visible disturbance can be seen distinctly in the southwest quadrant of Washington State beginning with the second photo. The disturbance, which grows more pronounced throughout the series, begins as a small circular plume of smoke. In the last photo, the smoke has spread over much of the State's lower half. GOES-West is a weather satellite operated by the National Oceanic and Atmospheric Administration (NOAA). It was launched from the Kennedy Space Center at Cape Canaveral on June 16, 1978. The unmanned craft operates in syncronous Earth orbit and monitors weather conditions over the Western United States. The eruption sequence was recorded by the satellite's automatic camera.





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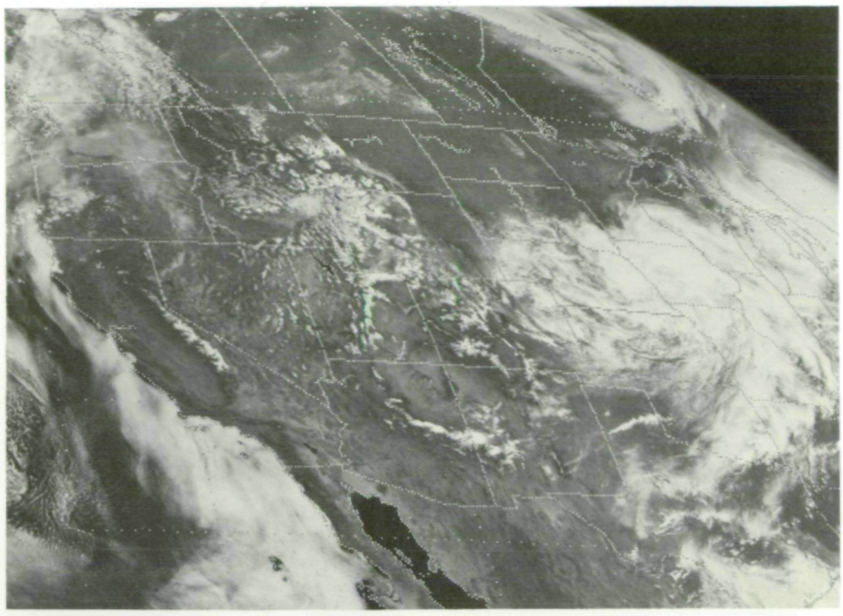

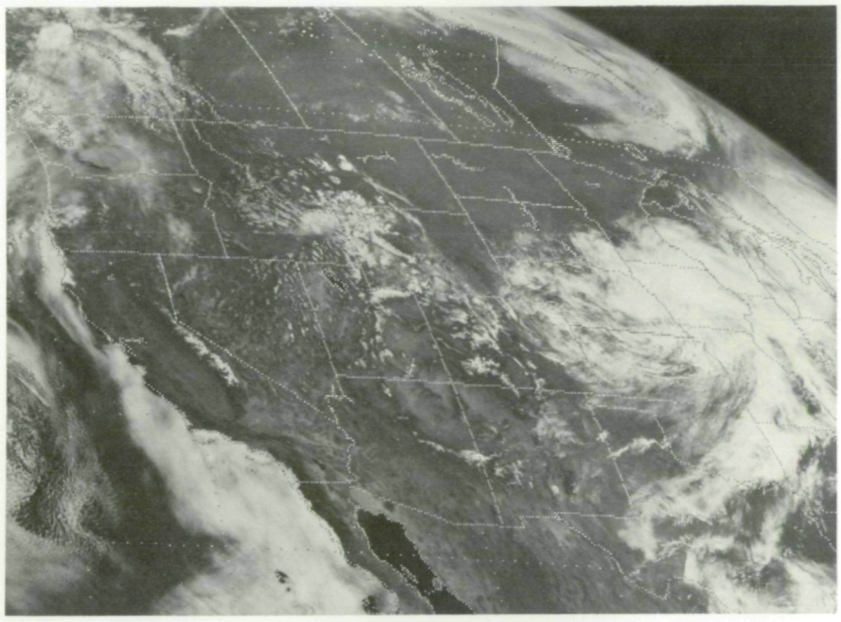

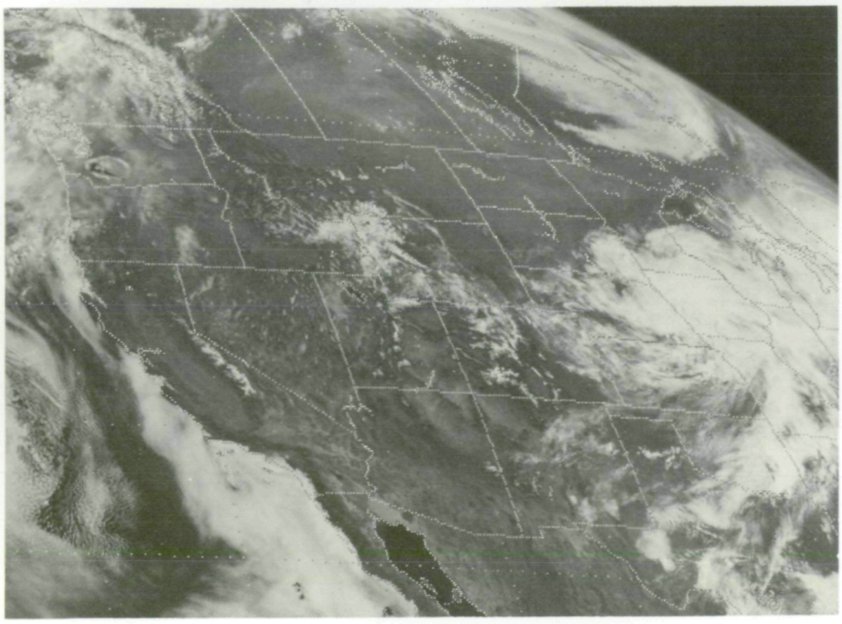

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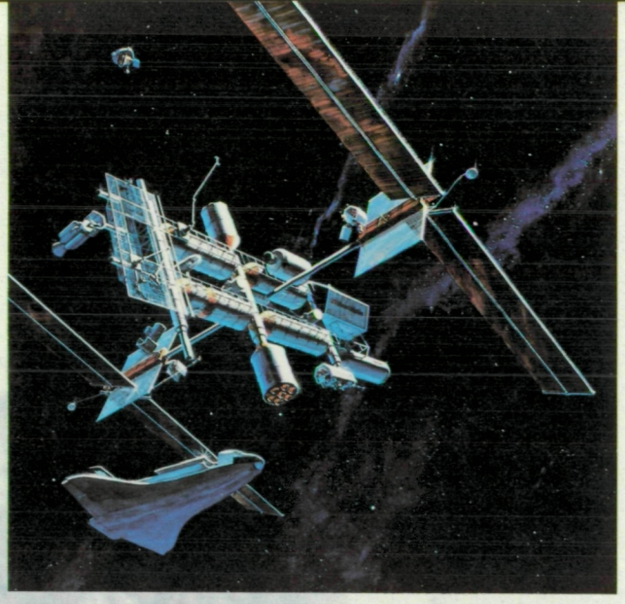
CONCLUSION



And what of NASA's next twenty-five years? Perhaps a 50th anniversary retrospective will picture space shuttles which operate on regular schedules. Their flights into orbit and return to Earth will be as ordinary an occurrence as the departures and arrivals of commercial jets. There may be dramatic photographs of great orbiting space stations on which scientists will spend months, even years of their lives, living and experimenting high above the Earth. Men and women might be pictured working in research facilities—on the Moon. Space explorers may land on Mars and return to Earth with samples of Martian rock, which will be shown in brilliant pictures, much as the pieces of lunar surface are shown today.

On NASA's 50th Anniversary, it will probably be written that NASA engineers have continued to find ways to produce more energy-efficient and versatile aircraft—airliners which can land on short runways within major cities, and even supersonic transports which can operate at lower cost than those of today.

Beyond the Earth and within the envelope of the Earth's atmosphere, the next 25 years will open new eras of planetary exploration and Earth applications for the benefit of all people.

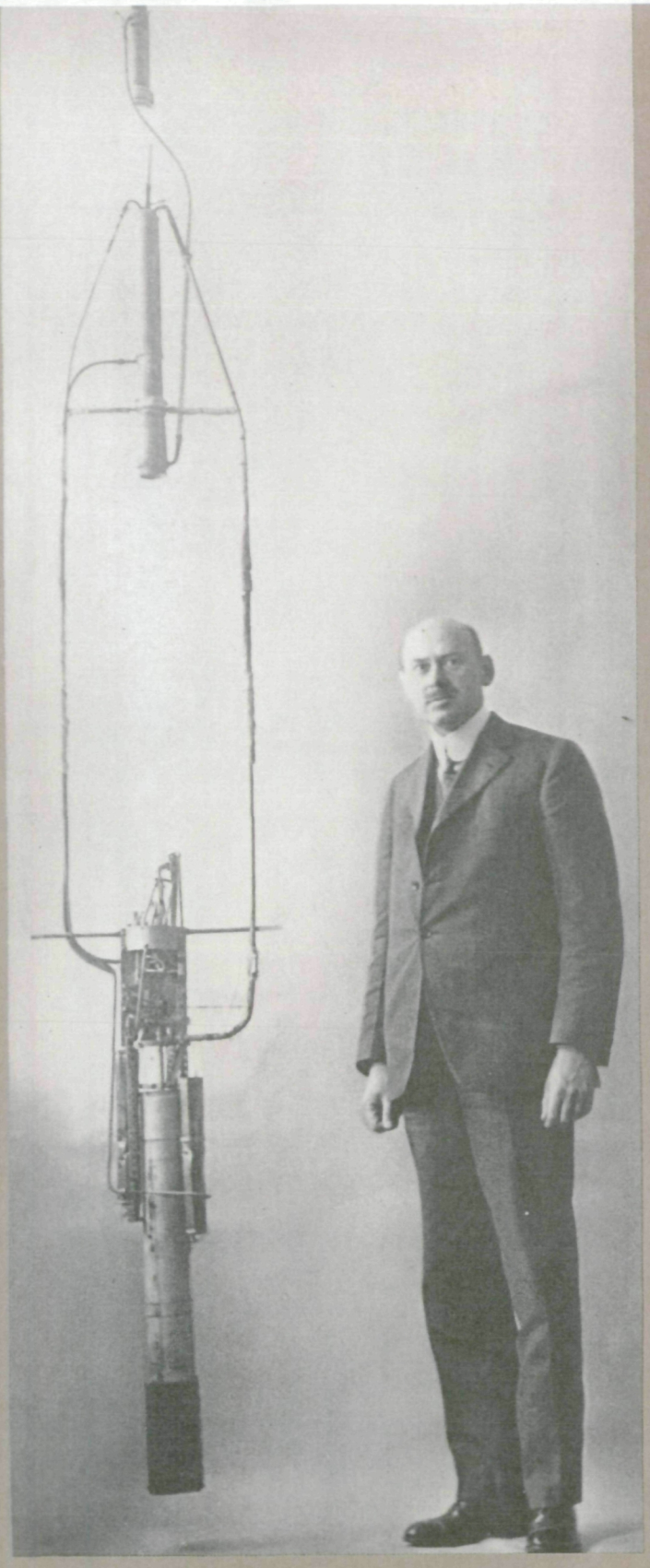
NASA's Infrared Astronomical Satellite (IRAS) has already discovered what may prove to be the forming—or early stage—of a solar system around the star Vega. Vega is located in the constellation of Lyra, the lyre or harp. If the circling debris around Vega is confirmed we have the first evidence of other solar systems and other planets.

With the past 25 years as our guide, the next 25 years will produce progress beyond our imagination. We may find: new forms of energy; new methods of transportation; new life support systems; new information about our Earth, our galaxy and our universe. We may even discover that we are not alone.

Extra-Vehicular Activity (EVA)
Astronauts Donald H. Peterson and F. Story Musgrave, STS-5 mission specialists, evaluate the handrail system on the starboard longeron and aft bulkhead during a long extravehicular activity (EVA) aboard the Earth-orbiting Space Shuttle Challenger. The vertical stabilizer and orbital maneuvering system (OMS) pods frame a portion of Mexico's state of Jalisco below. Punta Farallon and Bahia de Tenacatita, about 120 kilometers (75 miles) south of Puerto Vallarta, are photographed by one of two crewmembers who remained inside the spacecraft during the EVA. Astronauts Karol J. Bobko, Pilot, and Paul J. Weitz, Commander, took a number of pictures of their fellow crewmembers during their outside tasks.

". . . we must take stock of ourselves
and our universe.
We must send forth pontoons
into the night." *

Antoine de Saint Exupéry



Dr. Robert H. Goddard
1882-1945

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25th Anniversary
1958-1983

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